TV & VIDEO ✻ AUDIO ✻ COMPUTERS ✻ AUTO ELECTRONICS!

GET YOUR OWN EA COFFEE MUG!

NDD

Electronics

AUSTRALIA WITH ETI

JUNE 1995 $5.50*
NZ $7.30 incl GST

GIVING YOUR PC A 'MULTIMEDIA' UPGRADE

INVERTER FOR NORMAL & COMPACT FLUORO'S

MATCHBOX-SIZED CHESS COMPUTER

AUSTRALIAN PUBLICATION

Print Post Approved PP255003/01056

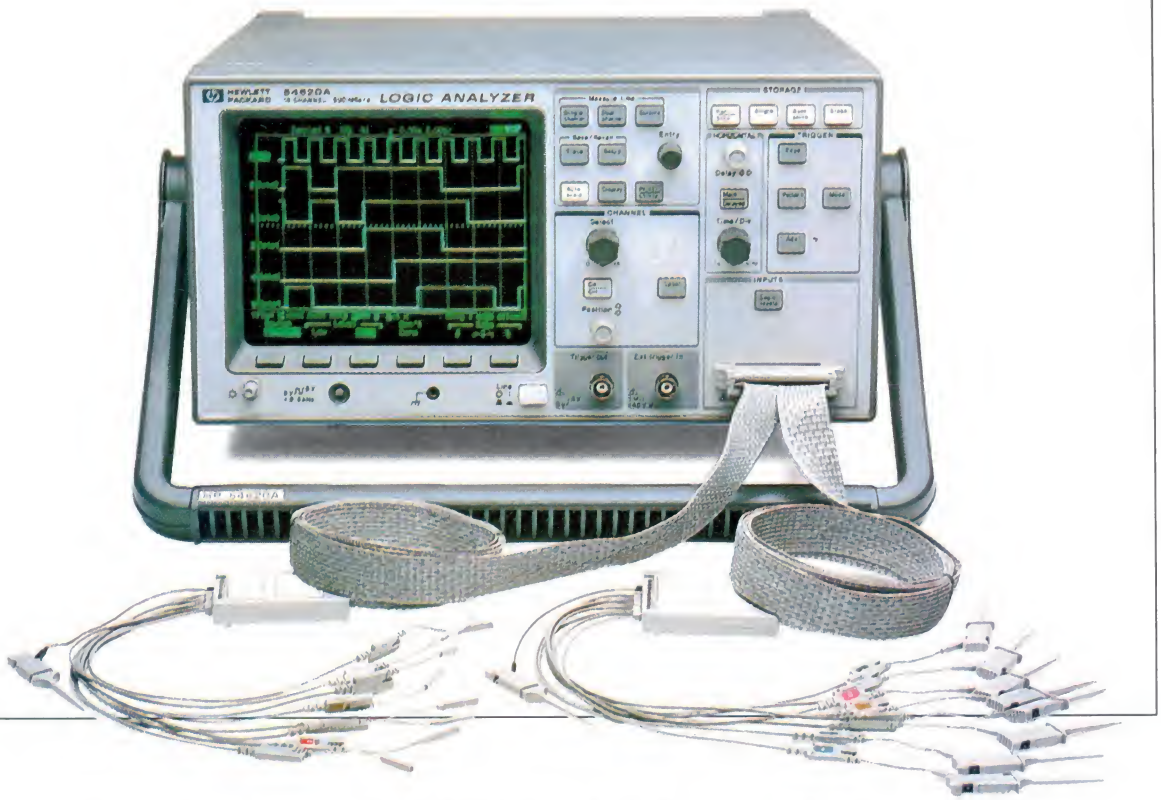
9 312966 123633 06

Feels like a scope.

Sets up like a scope.

Displays like a scope.

Could this really be a logic analyser?



Sixteen channels of 500 MSa/s logic analysis in a box that drives like a scope may seem impossible. Until you see the HP 54620A logic analyser.

Will this setup procedure convince you?

Connect the inputs, hit autoscale, look at the display. You'll get the benefits of logic analysis – including advanced triggering – without the learning curve.

The HP 54620A will change your attitude about troubleshooting.

Its range of triggering allows you to match the complexity of your problem. The high-speed display system shows you unstable signals. And because of its remarkably rapid display update rate and instantaneous feedback, you can operate this with a simple twist of a knob.

The HP 54620A – a logic analyser that really is as easy to use as your scope. A pretty convincing case.

So call our Customer Information Centre on **13 1347** (Australia wide) and ask for extension **2902**.

A better way.

HEWLETT® PACKARD

READER INFO NO. 1

Electronics AUSTRALIA WITH ETI

Volume 57, No.6
June 1995

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

'No glasses' 3D video

Perth-based Xenotech Australia has attracted interest from all around the world, for its patented projection 3D system which requires no special glasses. Already Korea's giant Samsung Electronics has signed a $1 million licence agreement, as we explain in our story starting on page 26.

Chess in a matchbox

One of our projects this month is this single-chip chess computer, which is so small that it will fit in a matchbox, along with its battery (but not the chessboard, of course!). See our story, starting on page 68.

On the cover

Graham Cattley, who recently joined EA's editorial team as a project developer and writer, is seen inspecting a CD-ROM drive before it was installed in the editor's PC, as part of a 'multimedia' upgrade. See our story on upgrading, starting on page 12. (Photo by Peter Beattie.)

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

Departments

MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO
GRAPHICS/PRODUCTION EDITOR
Mille Godden
TECHNICAL EDITOR
Rob Evans, CET (RMIT)
PROJECT DESIGNER/WRITER
Graham Cattley
CONTRIBUTORS
Louis Challis
Arthur Cushen, MBE
Peter Lankshear
Jim Lawler, MTETIA
Tom Moffat, VK7TM
Peter Phillips, B.Ed., Dip Ed., ECC
Nick de Vries, MIAME, AMSAE
Neville Williams, FIREE, VK2XV
DRAFTING
Drawquick Computer Graphics
COVER DESIGNER
Clive Davis
PRODUCTION
Ray Eirth
CIRCULATION MANAGER
Michael Prior
PUBLISHER
Michael Hannan
ADVERTISING MANAGER
Selwyn Sayers
Phone (02) 353 0734; fax (02) 353 0613.
ADVERTISING PRODUCTION
Karla Dixon, phone (02) 353 0713
SECRETARY
Anna Maria Zamora
HEAD OFFICE - EDITORIAL
P.O. Box 199, Alexandria 2015.
180 Bourke Road, Alexandria 2015.
Phone: (02) 353 0620. Fax: (02) 353 0613
Reader Services: Phone (02) 353 0620
Subscriptions enquiries: phone (02) 353 9992
Book Shop enquiries: phone (02) 353 9944
INTERSTATE ADVERTISING OFFICES
MELBOURNE: 504 Princes Highway, Noble Park, Vic 3174. Phone (03) 213 3222.
Fax: (03) 701 1534, Pilar Misa.
BRISBANE: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119.
Fax: (07) 252 3692, Graham Smith.
ADELAIDE: 98 Jervois Street, Torrensville, SA 5031. Phone: (08) 352 8666,
Fax: (08) 352 6033, Kerryn Delaney.
PERTH: Allen & Associates, 54 Havelock Street, West Perth, WA 6005. Phone: (09) 321 2998,
Fax (09) 321 2940, Tony Allen.
UNITED KINGDOM: John Fairfax & Sons (Aust), 12 Norwich Street, London, EC4A 1BH.
Phone: (71) 353 9321, Fax: (71) 583 0348
ASIA: Headway Media Services Ltd, Room 2101, Causeway Bay Centre, 15-23 Sugar Street, Hong Kong. Phone: 516 8002,
Fax: (862) 890 4811, Adrian Batten.
ELECTRONICS AUSTRALIA is published by Federal Publishing Company a division of Eastern Suburbs Newspapers Partnership, which is owned by
General Newspapers Pty Ltd.
A.C.N. 000 117 322,
Double Bay Newspapers Pty Ltd.
A.C.N. 000 237 598 and
Brehmer Fairfax Pty Ltd.
A.C.N. 008 629 767,
180 Bourke Road, Alexandria, NSW 2015.

Printed by Macquarie Print, 51 - 59 Wheelers Lane, Dubbo NSW, 2830, phone (068) 843 444, for Federal Publishing Company.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Road, Alexandria, NSW 2015; Phone: (02) 353 9911.
ISSN 1036-0212
*Recommended and maximum Australian retail price.
The Australian Publication emblem on the front cover of this magazine is there to signify proudly that the editorial content in this publication is largely produced and edited in Australia, and that most of the advertisements herein are the products and services available within Australia.

LETTERS TO THE EDITOR

Boxes not squiggles

It's high time, I feel, that the old controversy be resurrected. Since it last got a run, you have taken over copyright to the Elektor files, and they've been using rectangles as symbols for resistors, since Adam picked up his soldering iron.

We who use a drawing template for this, find it much easier and quicker than either hand drawing a 'squiggle', or using rubdown symbols from a pre-printed sheet. Much cheaper, too!

Many people though that your early opposition to boxes was perhaps a trifle xenophobic. That is, those of us unfinancial enough to decide we can live without fancy CAD facilities.

Can we please have a rethink about the pragmatism? Surely, many people are dissuaded from submitting circuits, because of a perceived bias, that "it's got boxes — it won't be printed!"

Come on, all you manual draughting designers. Let's hear it for boxes, not squiggles!

Peter Lucock,
Wynnum, Qld.

Comment: We don't have any rights to Elektor files, Peter. If we get a reasonable number of requests for 'box' symbols rather than 'squiggles', as you call them, we'll certainly consider changing. Frankly though, we prefer our circuits to show component function, if possible.

Computer museum

The Australian Computer Museum Society was formed to preserve early examples of computer hardware and software. Although we are attempting to collect all types of equipment, one of our main briefs is to preserve examples of Australian development and manufacture.

Although many people in industry are glad to help, some still suffer from the 'technological cringe' and many valuable early examples of Australian expertise are being tossed out.

We welcome information from your readers regarding ANY Australian computer development project they were involved in, for our database. We then can attempt to collect historic details or, if possible, the actual artifacts! It is surprising what people still have got tucked away under their bench. Remember, today's junk is the future's historic artifact.

We are also interested in a list of 'top ten' items that we should collect, and it would be interesting to get some input from your readers with their own 'list'. We are not just interested in hobby or IT equipment, but all aspects — including embedded processors such as washing machine controller cards, etc.

A good starting point would be your EDUC-8 computer, published in *EA* many years ago. This unit would have been the first introduction to computers for many of your readers. Another example is the Philips PSF200 microprocessor based traffic light controller developed in 1972. There must be many more.

Although we will of course, collect examples of the American Digital Equipment PDP-8, etc., they are being collected in many other places in the world — almost nobody else is collecting Australian computers.

One final item. We are fast running out of space to store our artifacts, so if anyone has a huge empty storage area they are not using — please let us know!

If any readers are interested in the above project, please contact John Rich on (02) 569 4965.

John Rich,
5 Queen Street,
Petersham, NS 2049.

CTV milestone

While I realise this letter may not be published until about May or June, nonetheless I'm writing to express disappointment that your March 1995 edition of *Electronics Australia* did not acknowledge the important milestone that occurred that month.

It was on March 1st 20 years ago that Australian television service made a quantum leap forward, by switching to full colour broadcasting.

This event was as important to the medium of television in this country as the beginning of the medium itself, when Station TCN-Sydney commenced transmission on 201-208MHz (VHF Ch.9) in September 1956, followed by a short time later by Station GTV-Melbourne on the same frequency range.

For my part I wrote a letter to the Federation of Australian Commercial

Television Stations advising them of this anniversary as well as ringing the three local broadcasters in my region: NBN, Prime and NRTV (now calling itself TEN-Northern NSW — to be honest, it was a daft move by them to take on their Sydney feeder's identity, but what's done is done) to advise them directly of this important date. Whether they do anything with it or not is up to them (I'm writing this at about 4.45PM on the day in question).

It seems to me that for all the publicity surrounding the event at the time, surely 20 years later the event could've been revisited and celebrated in a reasonable low key fashion.

There is no need to throw streamers, blow up balloons and have extravagant parties to celebrate the event, but, nonetheless, a milestone such as this deserved some recognition. This would've made up for the total lack of recognition for the first, fifth, 10th and 15th anniversaries of this event, in 1978, 1980, 1985 and 1990 respectively.

OK, now that I've gotten that bit of information in, I have a couple of other things to do in this letter. First I would like to apologise to Tom Moffat for inadvertently misleading him on Station 2-TM Tamworth and their conversion to FM. On a trip to the region in February of 1994 (Gunnedah, to be precise), I had occasion to pick up 2-TM's FM broadcast. This together with seeing the station's FM logo in a TV promotion for the schools' Rock Eisteddfod, led me to believe — wrongly, as it turned out — that 2-TM had indeed converted to FM and departed from their AM spot. I have since learned that 2-TM operates two services in the area, one a youth oriented (perhaps) FM service and the other, their long standing original AM service, complete with Nick Erby's Country Hoedown! My apologies, Tom! Can you ever forgive me?

Neil Forbes,
Stockton, NSW 2295.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT

The rise in cover price that we couldn't avoid...

As you've no doubt discovered by now, we've finally had to increase the cover price of *Electronics Australia*, and with this issue.

While price rises are never easy to accept in any product, this is in fact the first rise *we've* had for just on four and a half years. (We've been able to hold the price at $4.95 since January 1991.) Although there have been inevitable rises in many of our costs during that period, by careful belt-tightening we've managed to absorb these, so that they didn't have to be passed on to our readers. But in the last few months a significant change has occurred, in an extremely basic and crucial area as far as publishers are concerned: world wide paper supplies and costs.

People in other industries may not have noticed, but towards the end of last year many grades of paper became both harder to obtain, and more expensive — especially the stocks in common use for magazine, newspaper and catalogue production. The reason for this seemed to be that many of the world's economies had begun to move out of recession, and the increased demand had both drained supplies and forced up the prices.

Since then, the situation seems to have worsened, particularly in Australia — where two local paper mills announced that they were ceasing production of two of their most popular grades (one of which was the very stock we've used to print many of the pages in *EA*, for many years). Apparently this was done so that the mills could maintain their output of other stocks, particularly to large newspaper publishers.

In consequence, magazine publishers like our own company Federal Publishing have been forced to seek paper supplies from overseas mills, and inevitably pay a premium in terms of both the price ex-mill and the costs of transporting the paper to Australia. This has meant that in the last few months, we have seen the effective price of our paper rise by nearly 50% (with further rises predicted).

Needless to say, we simply couldn't afford to absorb an increase of this magnitude. So there were really only two options, if we were to remain viable as a publication: either reduce the size of the magazine (i.e., fewer pages), so that it used less paper, or keep it the same size, but increase the cover price instead. Neither option was desirable, of course, so we faced a proverbial 'heads we lose, tails we don't win' situation...

Although we knew that no one would welcome a price rise, we ultimately decided that *EA*'s readers would prefer a modest rise to seeing their magazine chopped back in size, or perhaps not able to continue at all. Particularly if we tried explaining the situation, as openly and as honestly as possible.

So that's the background to this price rise, which really couldn't be avoided. We deferred it for as long as we could, but finally it was forced upon us. I suspect that you'll see a similar or greater rise in the price of most other magazines, if they haven't already done so by the time you read this.

Jim Rowe

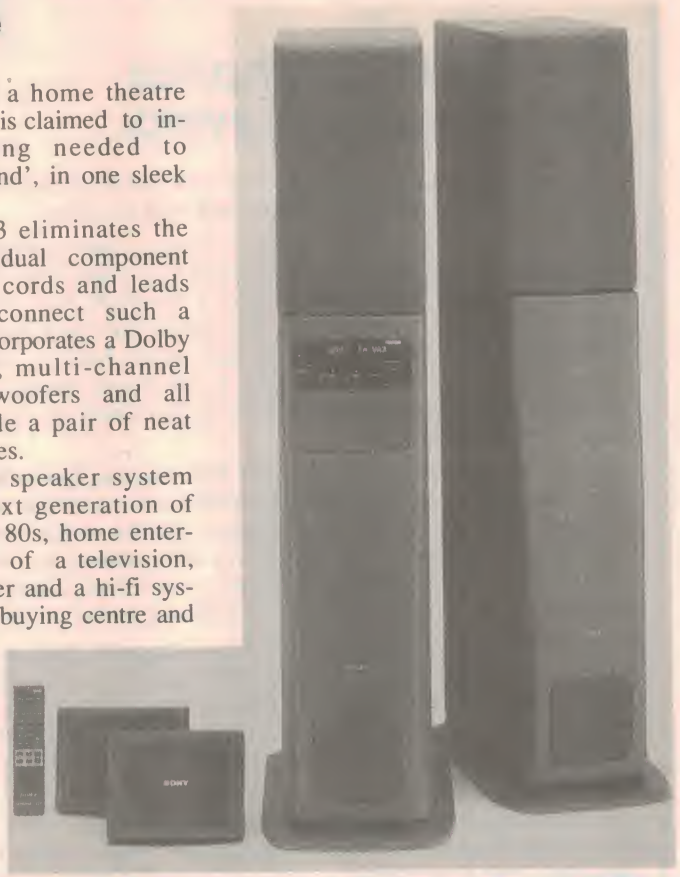
What's New in VIDEO and AUDIO

Integrated home theatre system

Sony has released a home theatre sound system which is claimed to incorporate everything needed to generate 'cinema sound', in one sleek integrated package.

The Sony SA-VA3 eliminates the need to buy individual component units and the many cords and leads often required to connect such a system together. It incorporates a Dolby Pro-logic Decoder, multi-channel amplifier, two subwoofers and all other speakers inside a pair of neat stylish tower enclosures.

"This new active speaker system takes us into the next generation of home theatre. In the 80s, home entertainment consisted of a television, video cassette recorder and a hi-fi system. We then started buying centre and rear speakers and Dolby Pro-Logic receivers which generated the sound around the room," said Sony's Product Manager for hi-fi, David Allen.



"The new SA-VA3 sound system has all the features and functions of separate component systems minus the fuss and bother of connection. The system is also stylishly designed to compliment any living area," he said.

The SA-VA3 is easy to connect, as only a single cord is required to connect both main speakers, supplying sound and power. The TV, VCR or laser disc player is simply connected to the SA-VA3 via the audio line outputs. Your 'Home Theatre' can be set up in less than 15 minutes.

Ideally, to generate the best sound possible, the towers should be placed on either side of the TV and the supplied rear speakers placed on the left and right behind the viewer.

The built-in amplifier is designed to match all drivers perfectly, in order to provide maximum performance for the channels. Seven separate amplifiers are used, improving sound quality and bass response, and also improving the channel separation between the five speakers. Total power output is 170 watts and major functions can be operated by the supplied remote control.

The Sony SA-VA3 is available at Sony 'Elite' stores for an RRP of $2299.

Innovative features in new colour TV's

Two new colour televisions from Mitsubishi are made to order for the seriously laid back viewer. Not only do the new TV's automatically adjust picture quality according to where you sit and how much light is in the room, but they can turn to the left or right via remote control. A special bonus for parents who wish to control when the TV goes on in their household is Mitsubishi's Child Lock.

Fuzzy logic technology, borrowed from Mitsubishi's top of the range DIVA TV, automatically responds to room lighting and the viewer's position to optimise picture quality. The Auto Turn facility, also previously only available on the DIVA, allows viewers to adjust the viewing angle via remote control. At the touch of a button, the set can be turned by up to 15° in either direction.

Known as CT-29AX1 and CT-25AX1, the new models have 68cm and 59cm screens respectively. Other DIVA technology used in the new models include picture improvement circuitry to provide improved contrast, and high resolution. Improved sound quality is also achieved with enhanced bass and a three way surround sound processor.

The AX1 series also features the 'Worldwide Multi 28 System', which allows viewing of broadcasts or videotapes from around the world without the need for a multi system VCR. Optional upgrades include picture in picture or Teletext. Recommended retail prices are CT-29AX1 $1999; CT-25AX1 $1699.

Compact Super VHS camcorder

Panasonic has released a new compact Super VHS camcorder called the NV-S90A, targeted at enthusiasts who want high quality video productions in an easy to use and compact format.

The S90 has high picture and sound quality, with hi-fi stereo and the Super VHS-C format, which is superior in quality to standard VHS. It also incorporates a new CD image sensor featuring a full 680,000 pixels (a conventional camera has 420,000 pixels).

A variety of digital functions, including the new 'Super Image Stabiliser' and 20X digital zoom, allow the user to enhance video productions. Other functions include Digital Mix, Digital Wipe, Digital Strobe, Digital Gain-up and Snapshot Record. Digital Zoom takes over from the optical zoom at 10X magnification and covers the 11X to 20X zoom range.

The built-in time base corrector (TBC) reduces picture instability known as 'jitter', thus improving the vertical picture information without replacing the original synchronisation signals.

The S90 also features VITC (vertical interval time code) 'Read' and 'Write' functions, to provide professional grade

editing time coding by giving each picture a time code. An Audio Dubbing mode also allows creative editing. Other features and functions include a single switch start, on-screen menu, large on-screen display, one piece aluminium diecast chassis and auto date recording.

The NV-S90A camcorder is available from electrical retailers and duty free outlets for a recommended retail price of $2999.

Twin-wall speaker systems

Sydney-based firm Architectural Audio Design, which specialises in the design, supply and installation of built-in audio systems, has released a number of new products from specialist US manufacturer Sonance.

The three-way D6000 system is now the 'flagship' model in the Sonance in-wall speaker line, combining a 200mm dual voice-coil woofer with a 63mm poly cone midrange driver and a pivoting 18mm aluminium dome tweeter, with ferrofluid cooling and twin neodymium magnets.

The D6000 has a nominal impedance of 6Ω, a power handling capacity of from 5W to 100W, an efficiency of 91dB (1W/1m) and a frequency response of 39Hz - 21kHz +/-3dB. It also provides eight selectable level settings for the tweeter, four for the midrange and eight for the woofer — giving a high degree of flexibility for optimisation in a given environment.

External dimensions are 254 x 407 x 77mm, and the D6000 requires a cutout of 378 x 225mm.

The D5500 is also a three-way system, virtually identical in size to the D6000 and with similar ratings. However in this case the pivoting 18mm ferrofluid cooled tweeter uses a soft dome, while the 63mm midrange driver has a treated paper cone. The rated frequency response is 39Hz - 20kHz +/-3dB, with an efficiency of 90dB (1W/1m). The switch panel provides over 60 settings for room optimisation.

Next in the line is the D5000, again a three-way system but with a 15mm pivoting poly dome tweeter, and a power rating of 5 - 75W. This system has a rated frequency response of 45Hz - 20kHz +/- 3dB, a nominal impedance of 8Ω and an efficiency of 90dB (1W/1m). The D5000 has a switch panel providing 15 settings, and its external dimensions are the same as for the other two models.

Other new products in the Sonance line include the S1R, a two-way round system combining a 172mm polypropylene cone woofer with a concentric 50mm cone tweeter, and the VC101 and VC51 — two new switched low impedance stereo volume controls, featuring 12 level settings (max attenuation -42dB) and power ratings of 100W and 50W per channel respectively.

Further information on the Sonance range is available from Architectural Audio Design, Suite 3A, 600 Military Road, Mosman 2088; phone (02) 968 3299, or fax (02) 968 2548.

Personal CD player from Sanyo

Sanyo has released four new personal CD players, two of which feature an anti-shock system to allow uninterrupted listening while jogging, walking or driving over rough ground.

The top of the range model, CDP-67, has a digital anti-shock system with 2.4 second shock compensation memory and a wired remote control unit for easy

control over volume and main player functions. With a 22 track random memory, repeat function and pre-programmable facility, you can play back your music in any order you like. A DSP (digital sound processor) system is included, providing three preset sound patterns for enhanced music realism.

Other features include a multi-function LCD with a two digit current track number indication and time elapsed/time remaining indications. For easy reading at night the display is backlit.

A special hold switch stops the player from going into operation mode accidentally when the player is carried in a pocket or bag, while the automatic power off function saves batteries by switching the player off when the disc ends. All the models in the range have 'line out' sockets which means the units can be connected to a larger audio system when you don't require portable sound.

Retail prices are: CDP-67 $449, CDP-60 $399, CDP-47 $259, and CDP-41 $249. ❖

AKAI'S VS-G2100 'INTELLIGENT' VCR

This month Louis Challis turns his critical attention towards the current top-of-the-line model in the Akai range of video cassette recorders. The VS-G2100 offers many impressive features, coupled with outstanding performance — but may possibly represent 'over kill' for those who find themselves a little intimidated by modern electronic gadgetry...

Early in January 1991, I caught a late afternoon US air flight from Las Vegas to Los Angeles. The hostess seated me next to a young man, who quickly involved me in conversation. One of his first questions was whether I had enjoyed the Winter Consumer Electronic Show (CES)?

I blinked, and inquired how did he know that I had *been* to the CES? He responded that the large bag of what appeared to be paperwork that I had placed in the baggage cubicle, was the only real clue that he had. I rejoined by asking him, whether he too had been to the CES and if he had, what was *his* particular interest in electronics?

A strange tale soon unfolded. I discovered that this young man had come to the CES with the express purpose of learning as much as he could about the complexities of the new consumer electronic equipment, which were about to be released on what he referred to as the 'unsuspecting public'. These complexities, it seems, had created a new and relatively innovative market for his talents.

He boldly recounted how he advertised his services in the local papers of Los Angeles, as well as by way of letter drops, selling his services to those unfortunate people who couldn't understand the handbooks of their new and expensive electronic appliances. He explained how he had turned what had initially been unsolicited requests from neighbours, to explain to them how to use their equipment, into a full time profession.

The more complex the equipment (or its remote controllers) became, the more quickly his market grew. A significant proportion of his clients were widows whose husbands had previously fulfilled such chores, and now these poor widows were being dragged into 20th or 21st century, with what he described as being a 19th century comprehension of electronics.

The young man went on to gloat that, not only was he making a living, but his reputation was being spread by 'word of mouth'. Each successive generation of more advanced remote controls or related 'state of the art' advances in VCR technology had created a burgeoning market for his talents.

Not surprisingly, almost every revolution generates a counter-revolution. The electronics revolution with its microprocessor controls and associated remote controls, with improved and RF links, has created the counter-revolution. The market place now cries out for 'more user friendly' equipment which caters for people of all ages. Unfortunately it appears that the young have no problems; it is only the older or elderly members of our society whose noses appear to be 'put out of joint'.

Akai was amongst the first of the VCR manufacturers to realise that its intending purchasers wanted equipment which was easier to use.

The company's marketers realised that a significant proportion of the more affluent purchasers have failing eyesight, that many are now forced to wear glasses for the first time in their lives, and they have difficulty in reading the symbols on the remote control.

In 1982 Akai introduced the first Interactive Monitor System (IMS), which provided large on-screen displays and simple programming instructions, in their model VS-2 VCR. I reviewed one of the first of those VCRs, and was impressed by its convenience and by its sensible ergonomic features.

Whilst many other manufacturers have followed that lead, it seems that Akai has consistently been 'at the head of the pack'. They have continued the development of innovative concepts, with the aim of producing a better product that is easier to use.

As you may have observed, one problem tends to be that when any product sets out to outdo its competitors, then the general corollary tends to be that its complexity is similarly increased. Ultimately this leads to more buttons, bells and whistles, and the product that started off having attributes of simplicity and ease of use, tends to drift in the other direction.

The new Akai VS-G2100 video cassette recorder manifestly exemplifies this trend, and although it is a fine VCR, its buttons, bells and whistles turn it into a relatively complex piece of equipment, which ends up being best suited for the person who is computer literate, or who adores gadgets.

The VS-G2100 is the latest, and unquestionably the greatest, of a long line of top quality Akai VCRs. It incorporates more than 30 special features, many of which must be regarded as being 'state of the art'.

Its primary features can be summarised as follows:

- **Two-speed recording and playback** (i.e., standard speed and long play, which provides the ability to record up to eight hours of video on a quality four-hour tape).
- **Super intelligent HQ**, which is the most important feature of this recorder. This was an Akai development, and provides significant improvements in recording quality. Super intelligent HQ is based on the principle that the VCR will automatically evaluate the magnetic characteristics of any tape used during its initial phase of recording. The recorder then re-adjusts the recording signal strength, as well as the RF bias signal to optimise the subsequent recording process. The VCR also incorporates the current AUTO CHROMA CONTROL (CACC) circuit, which reduces colour saturation problems. These normally manifest themselves as colour smear, and with well defined quality pictures, can be disturbing.
- **Intelligent HQ on playback**,

Measured performance of VS-G2100 Video Cassette Recorder
Serial No. B9465-00516

Frequency response	SP	10Hz to 20kHz +0.3	-2.4dB
	LP	10Hz to 20kHz +0.2	-2.0dB

Harmonic Distortion (in SP Mode at indicated level)

Distortion Component	**100Hz 0VU**	**100Hz -20VU**	**1kHz 0VU**	**100Hz -20VU**	**6.3kHz 0VU**
2nd	-61.3	-65.2	-42.5	-56.2	below
3rd	-	-	-43.9	-66.9	the
4th	-75.5	-69.7	-47.5	-	noise
5th	-80.7	-	-58.2	-	threshold
THD%	0.89	0.064	1.1	0.16	

Signal to noise ratio	SP	-77dB(A)	-67.5dB unweighted
	LP	-72dB(A)	-60.0dB unweighted

plus a detail enhancer circuit which ensures that there is minimal distortion, through the use of a refined 'linear feedback' equalisation circuit, supplemented by a linear noise cancellation circuit. The nett result is a cleaner, sharper and more finely controlled playback signal, and as I can attest, the results are readily observed in A-B testing.

- **On-screen programming**, with a choice of eight languages including English, German, Spanish, Italian, Dutch, Swedish and most surprisingly, Finnish. This feature is of minimal advantage in Australia, but is a real plus in Europe. The language change is achieved through the use of an on-screen menu, as are most of the other critical functional changes.
- **G-Code simplified programming** is incorporated in the remote control, as are some 40 other functions. The remote control is neat, attractive and functional. It incorporates its own LCD display and time clock, with controls divided into two main groupings. Those which are frequently required for channel changing and related functional controls are placed on the external casing, while other less frequently required controls are placed under a cover. The G-Code function is very simple in use, and I believe will ultimately be adopted as a Universal feature on all medium performance and 'top of the line' VCRs.
- **Quick Servo Drive**, which speeds up the recording startup process to less than one second following the placement of the video cartridge into the recorder. This works exceptionally well.
- **An NTSC playback facility**, so that NTS videos can be replayed on an existing TV which is designed for PAL format reception. This is a real plus, particularly if you don't wish to purchase a more complex and more expensive TV set or monitor.
- **Digital Stereo sound recording**, with full control over the audio channel's recording levels, using the multiplex hi-fi stereo capabilities. The digital stereo signal quality is outstanding, as I discovered, and offers a cost effective alternative for recording high quality music — with up to eight hours of playback.
- **Flickerless Still and Slow Motion Replay**, and also Jog Shuttling on the front panel and via the remote control. To achieve true flickerless control, the manual controls on the remote control must however be used to achieve the best performance.
- **Quick Timer or Simple Timer programming**, with the ability to record eight programs sequentially.
- **The VCR is pre-tuned for channels 2, 7, 9 and 10**, with a delightfully simple automatic tuning procedure for setting other channel frequencies that may be required — i.e., channel 28 in Sydney.

Other features which I felt most users would value include:

- External video and audio input jacks on the front panel.
- A microphone socket on the front panel for audio dubbing, when adding dubbed or new sound tracks to an existing pre-recorded video.
- Multi-speed forward and reverse video playback, with transport speeds as high as seven times normal play speed.
- A 'real time' counter, displaying elapsed time in minutes and seconds, which can be displayed on the upper RH corner of the monitor screen.
- A remaining time indicator displays how much recording time is left on the tape (but without the precision of the real time counter).
- A quick timer and sleep timer, to expedite switching on and/or simplify switching the VCR off.
- An auto head cleaner which automatically cleans the head when a tape is loaded or unloaded. Most Akai video recorders now offer this as a standard feature.
- A DEMO MODE facility is incorporated, so that with a pre-recorded tape loaded the VCR will demonstrate many — but not all — of its most important features to the user.

The plastic moulding of the remote control has been tapered, and has a sensible shape that fits well in the hand. It provides normal channel selectors (UP or DOWN), PLAY, STOP, FAST FORWARD, REWIND, RECORD, and PAUSE/STILL together with POWER ON/STANDBY, TV or VCR, an EJECT button, and INDEX FORWARD and REVERSE buttons.

The Jog Shuttle's rotary control knob at the lower end of the remote control is smooth and effective. The vast majority of special functions can only be accessed by means of the remote control, and the majority of those special functions are accessed by lifting the hinged cover.

With the cover raised, a further 28 pushbuttons and four directional controls are immediately accessed. Many of these pushbuttons and controls provide dual functions. They do however provide tremendous control flexibility, and as I found, the potential power increases as you become familiar with the idio- syncrasies of the system.

When first reading the handbook, some intending purchasers could well be discouraged by the 40-odd pages of detailed instructions. Unfortunately, when a piece of equipment contains as many features as the VS-G2100, those instructions are absolutely essential. Whilst Akai may have intended that this VCR be described as 'user friendly', I suggest that that accolade is more appropriate for some of the firm's more economical VCRs, which offer limited controls in keeping with the user's potential needs.

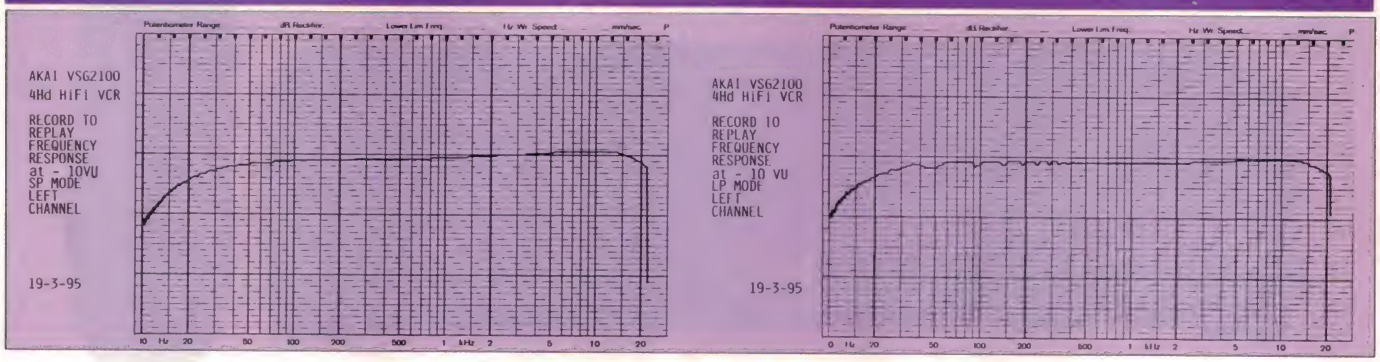
Two-stage evaluation

I decided to evaluate the VS-G2100 VCR in two stages. The first stage involved a laboratory evaluation of its electro-acoustic performance. That was followed by a subjective evaluation of its video characteristics, using pre-recorded tapes and special demonstration software. The laboratory assessment of the VCR's audio characteristics was interesting, and it provided an insight into just how good the latest generation of VCRs with digital audio channels have become.

The advantage of a two-speed VCR is that when used in the 'standard play' (SP) mode, the recorder should provide an almost flat frequency response from 20Hz to 20kHz, supplemented by optimum video performance. When switched to operate in the 'long play' (LP) mode, a modest reduction in the overall frequency bandwidth and some reduction in total dynamic range must be anticipated. The magnitude of that reduction is primarily determined by the quality of the design, and in effect constitutes a means of assessing the quality of the VCR.

As I soon discovered, the VS-G2100 provides outstanding audio frequency RECORD/REPLAY performance in the SP mode. The frequency response is just over 1dB down at 20Hz, and is only 0.3dB high at 20kHz. The flatness and overall smoothness of the performance is exemplary, and both channels display the same characteristics.

My evaluation of the overall *linearity* of the audio record to replay characteristics, following the latest procedure specified by DIN 45657, reveals a response that is exemplary all the way down to -71dB. Following that demanding test, I was not surprised to find that in the SP mode, the recorder provides an A-weighted signal to noise ratio of 77dB(A) relative to +6VU. In like manner, the distortion



On the left is the record to replay audio frequency response of the VS-G2100, in standard play (SP) mode. On the right is the record to replay response in long play (LP) mode, for comparison. Note the ripples at the low frequency end.

levels at 0VU and -20VU are relatively low at 1kHz, but were moderately high at low frequencies, being 1% at 100Hz and 0VU. The harmonic distortion components at high frequencies are again particularly low, and at 6.3kHz were below the noise threshold.

In the LP mode the audio channel frequency response proved to be marginally flatter and smoother, with a slightly better low frequency response. The droop at 10Hz was -2.8dB, whilst at 20Hz it was -0.5dB.

One unexpected characteristic that caught my eye was the cyclical ripple in the LP record-to-replay response curve. The ripple manifests itself as a series of cycles, each of which occurs at increments of 50Hz. The peak to null ratio of the ripple is not high, being less than 0.2dB overall at -10VU, but that ripple is indicative of a slightly higher level of mains hum leakage being recorded and replayed in the LP mode.

What really surprised me was the overall bandwidth provided by the LP mode. The high frequency response rolls down ever so gently, by 0.4dB between 10kHz and 20kHz. The frequency response in the LP mode is therefore, to all intents and purposes, on par with the SP mode. Whilst the dynamic range is not quite as good, this VCR provides a very practical and cost effective means of recording eight hours of stereo mood music, with digital quality on a $10 video cassette.

Subjective testing

My evaluation of the video recording characteristics involved a series of subjective assessments of the recorder with pre-recorded material. The first demonstration tape that I used was a recent pre-recorded hi-fi VHS video, entitled *Vladimir Horowitz — A Reminiscence*. This video runs for almost two hours, and is an outstanding anthology of a musician's life. The VS-G2100 provided exemplary playback of this Sony Classical video (SHV 53478), providing some of the most outstanding and exciting music with video that I have had the pleasure to watch. I used a pair of B&W monitor speakers connected to an Akai TV set CT-K 2976, and the quality of the sound was fantastic.

I viewed a second Sony pre-recorded video, entitled *Dvorak in Prague — A Celebration*, with Seiji Ozawa conducting the Boston Symphony Orchestra, in a program celebrating the centenary of Dvorak's New World Symphony premier performance in New York. The soloists were Yo-Yo Ma, Itzhak Perlman, Rudolf Firkusni and Frederica von Stade, backed by the Prague Philharmonic Chorus. The celebration took place in Smetna Hall in Prague, and the quality of the music and the intimacy of the video is one over which I can wax lyrical.

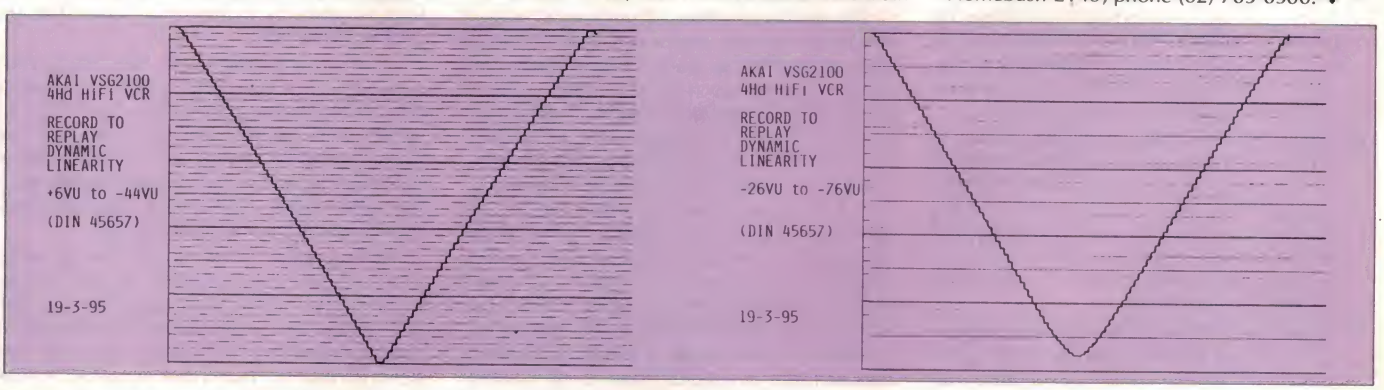
I conducted A-B comparisons of the performance of the VS-G2100 VCR against my current hi-fi VCR and a two year old 'top of the line' Akai VCR. As I soon discovered, the video quality of the VS-G2100 VCR on replay was significantly better than the two other VCRs, and the quality of picture was matched by an equally superb quality of sound.

The picture exhibited less colour smear, and significantly better detail resolution than the other two VCRs, and I found that it was both quick and easy to use. To ensure that I wasn't judging the outcome on the basis of the quality of the TV set, I swapped the videos around to assess the performance with the alternative monitors. The result was a resounding first place, and best overall performance for the VS-G2100. I continued my assessment to evaluate the performance of the VS-G2100 with its G-Code remote control, and found that it was easy to use and far more convenient than the current separate G-Code module that I use with my VCR.

The most obvious advantages of the Akai VS-G2100's remote control is that the G-Code information is transmitted directly from the remote control to the VCR, so that problems of the type that I have experienced with my current G-Code module (resulting from its being repositioned or disoriented by my grandchildren, or visitors) are positively and simply avoided.

After an extended assessment of the VS-G2100, I have no qualms in commending this recorder for any intending purchaser who seeks 'the ultimate' in flexibility, functionality and matching technical performance. If however your quest is a VCR that is just easy and simple to use, and you have no real need for all those 'bells and whistles', then Akai has a range of good VCRs which are more likely to suit your needs. The physical dimensions of the VS-G2100 are 425 x 289 x 104mm and it weighs 5kg. The quoted RRP is $1099.

For further information on the VS-G2100 or any of the other VCRs in the Akai range contact Akai Customer Service, PO Box 11, Homebush 2140; phone (02) 763 6300. ❖



These plots show the record to replay dynamic linearity of the VS-G2100, measured according to the DIN 45657 standard. As you can see, its extremely good right down to -71dB.

Multi-Choice.

Whether you're doing first-level troubleshooting or component-level diagnosis, Fluke meters offer you one of the widest choice of capabilities and price ranges in the industry. Choices ranging from the basic Fluke 12 with auto function V-Chek™ and Continuity Capture™. To the classic Fluke 77 with Auto Touch Hold® and current measurements.

Fluke 77
The classic
Multimeter

To the advanced Fluke 83 with Min/Max/Average recording, Frequency, Duty Cycle and Input Alert™. Plus a full line of quality accessories to extend those capabilities even further. No matter which Fluke meter you choose, you can count on precise, reliable, consistent performance year in and year out. Plus, strong customer support and product warranties that measure up to any in the industry. Make the choice that gives you the most choices.

Fluke 83
Full-featured
Multimeter

FLUKE 12	FLUKE 77	FLUKE 83
The Fluke meters listed above feature DC/AC voltage, resistance, audible continuity and diode test.		
Capacitance measurements	Auto Touch Hold®	Auto Touch Hold® and Relative modes
V Chek™ (auto function)	Current measurements	Current measurements
Min/Max Record with Relative Time Stamp	Analog/Digital display	Analog/Digital display
Two-year warranty	Three-year warranty	Three-year warranty
Continuity Capture™	Yellow holster with Flex Stand™	Yellow holster with Flex Stand™
Basic accuracy 0.9%	Basic accuracy 0.3%	Input Alert™
	For measurements to 4800 V-A	Capacitance measurements
		Frequency and Duty Cycle
		Min/Max/Avg. Recording
		Basic Accuracy 0.3%

Look to Fluke

Call Philips Test and Measurement on (02) 888 0416

for your nearest Fluke Distributor.

Fluke 12
Auto-function
Multimeter

READER INFO NO. 2

FLUKE®

UPGRADING YOUR PC WITH A 'MULTIMEDIA' KIT

Nowadays it has become almost essential for a PC to be fitted with a CD-ROM drive and a sound card. Luckily you can now also add these facilities to an existing computer at relatively low cost, thanks to the good deals being offered on 'multimedia' upgrade kits. Here's the information you'll need to perform this kind of upgrade, using as an example a representative kit from Rod Irving Electronics: the KTX DS-16.

by JIM ROWE

About two years ago, I upgraded my home PC by fitting it with a CD-ROM drive and a sound card. At the time, this upgrade cost around $1000 — partly because the double speed CD-ROM drive I wanted needed a SCSI interface, and that involved getting a SCSI adaptor card along with the sound card. It was all fairly complicated to install, as well.

Things have changed quite a bit, since then. For less than *half* the figure I paid in 1993, you can nowadays get a 'multimedia' upgrade kit complete with double speed CD-ROM drive using the IDE (integrated device electronics) interface, a sound card, a pair of small speakers and some very useful 'big name' bundled software on CD-ROM discs. Without the bundled big name software, you can get the hardware alone for less than $400, while an IDE double speed CD-ROM drive by itself can cost as little as $200.

Mind you, things are still changing, and prices are still falling. By the time you read this review, the prices of *quad* speed CD-ROM drives are likely to have fallen to the $500 mark or less, and upgrade kits including them may be replacing those like the one we're discussing here. The first *hex* speed drives have just started to appear, and although these will no doubt be fairly expensive for a while yet, they'll no doubt become more attractive in time.

(By the way, 'double speed' simply means that when the drive is reading a CD-ROM disc, it spins it at twice the speed of a normal audio CD. This means that the data can be read from a disc at twice the original speed, or 300KB per second instead of the 150KB/s of the first 'single speed' drives. The newer 'quad speed' drives double the speed and transfer rate yet again, to 600KB/s, while the very latest 'hex speed' drives reach 900KB/s. These rates are for continuous or sustained data transfer; most drives can achieve faster rates for short bursts of data.)

Even though the particular upgrade kit we're using as an example in this article may be technically 'obsolete' quite soon, then, we thought it might be worthwhile to use it to present a kind of snapshot of the current situation, regarding 'multimedia' upgrades. Hopefully if nothing else it will give you an idea of what to expect, if you decide to upgrade your own PC in this way.

The upgrade kit we're going to discuss came from Rod Irving Electronics, and is apparently used in some of RIE's own complete multimedia computers, as well as being sold separately. It includes the following items:

1. A double speed 'internal' CD-ROM drive, which fits in a standard half-height 5.25" floppy drive bay, and uses the IDE interface.
2. A 16-bit stereo sound card, fully compatible with the *de facto* standard established by the Adlib, Sound Blaster and Sound Blaster Pro cards.
3. The necessary cables, manuals and installation software for both Windows and DOS.
4. A pair of small 'outboard' speakers, to hook up to the sound card's inbuilt stereo amplifier.
5. A bundle of applications software on CD-ROMs, consisting of the following packages:

- Microsoft's *Encarta '95*, the extremely popular interactive multimedia encyclopedia.
- Microsoft's *Works for Windows*, the popular suite of office software which includes a word processor, spreadsheet with charting, database with reporting, communications program and drawing program.
- Microsoft's *Money*, the personal finance management program.
- A fourth CD-ROM called 'CD Deluxe Pack 4', which provides *Chessmaster 4000 Turbo*, *Mavis Beacon Teaches Typing V2.0*, *The Software Toolworks US Atlas V4.0* and *The Software Toolworks World Atlas V4.0*.

And at the time of writing, the price for this complete package is only $449.00 — surely excellent value for money, considering that the three Microsoft packages alone would probably cost close to this amount, if they were purchased separately.

The CD-ROM drive

Let's take a closer look at the two main hardware items, the CD-ROM drive and the sound card, before we look at what's involved in fitting them into a typical PC.

The latest breed of CD-ROM drives are designed to connect into a PC using an enhanced version of the same IDE interface used for most hard disk drives, known as the ATAPI interface (see data panel). With the IDE/ATAPI system, the drive's 'controller' is built right into the drive itself, and communicates directly with the computer's CPU.

The drive electronics are effectively allocated to a 'port' in the computer's I/O memory space, just like a printer or serial communications port. And in the same way, data flows between the drive controller and the CPU via a similar sequence of interrupt requests (IRQ's), programmed bus transfers and direct memory access (DMA) channel transfers. So with the IDE system, a CD-ROM drive is allocated a specific I/O address, IRQ line and DMA channel — just like a hard disk or serial port adapter card.

This means that if you have only a single IDE hard disk, like most people, this type of CD-ROM drive can be connected to the same IDE port on your mother board or 'paddle' card, as the secondary or 'slave' drive (the HDD becomes the primary or 'master'). How-

Along with the main items shown here, the RIE kit includes further software and all necessary cables.

ever since many of the modern sound cards also provide a second IDE port, specifically for a CD-ROM drive, it's just as easy to use this if it's available. Often this approach is also more straightforward.

Physically an 'internal' CD-ROM drive is almost identical in size to a standard 'half height' 5.25" floppy disk drive, and mounts into the computer in the same way.

It runs from +12V and +5V obtained from the PC's power supply, using one of the same four-way power leads used by the hard and floppy disk drives. A 40-way ribbon lead connects it to the IDE port connector, and a small four-way audio lead connects it to the mixer/amplifier on the sound card for playing audio discs.

The CD-ROM drive supplied in RIE's KTX DS-16 kit has a motor-driven tray assembly like most modern audio players, and doesn't need each disc to be fitted into a protective 'caddy'. On the front panel it provides a 'tray open/close' button, an 'audio play/skip track' button, an earphone jack and volume control for listening to audio CDs, and a green LED which indicates disc reading activity. When open for loading or unloading, the disc tray can also be closed by giving it a small push inwards.

The sound card

Turning our attention now to the sound card, you're probably aware that most of today's sound cards combine a number of essentially separate functional blocks:

- A digital audio 'codec' (coder/decoder), able to perform A-D and D-A conversion of audio signals (generally in stereo), at a variety of sampling rates. Quite often it can also perform compression and decompression of the digitised audio, for smaller file sizes and efficient file transfer.
- A music synthesiser, able to produce stereo simulations of a variety of musical instruments in response to MIDI (Musical Instrument Digital Interface) commands.
- A joystick/external MIDI port, for connecting an external joystick for playing games, and/or a MIDI breakout box for linking the computer to an external MIDI synthesiser, keyboard and other instruments.
- A small stereo audio amplifier, typically with an output of 2W per channel, and capable of driving a pair of external speakers. Often a software-driven mixer and volume control is built into the amplifier, allowing convenient setting of the volume from the digitised audio D-A, music synthesiser or CD-ROM player when playing an audio disc.
- In most cases, a 'secondary' IDE interface port, intended to service the CD-ROM drive.

As you can see, there are quite a few distinct subsections of a sound card, and a number of them need their own I/O port address, and possibly their own IRQ line and DMA channel setting so that the CPU can communicate with them without confusion.

This applies to the audio codec, the music synthesiser, the joystick/external MIDI port and the IDE/ATAPI port for the CD-ROM drive. That's why sound cards traditionally end up with quite a few header pin strips and jumpers, and why setting them up to work correctly in a particular computer can often be a bit of a nightmare.

In fact, it was probably sound cards that someone had in mind, when they coined the somewhat ironic phrase 'Plug and Pray', to describe the current situation when you're adding cards and peripherals to a PC. The recently proposed 'Plug and Play' standard is intended to solve these sorts of problem...

The 'SP300' sound card in RIE's KTX DS-16 kit is a half-length card which provides virtually all of the above functions. The audio codec handles 8-bit or 16-bit sampling of stereo signals, at rates up to 44.1kHz — which makes it nominally capable of making CD-quality recordings. It can also perform either ADPCM or ESPCM compression and decompression, in the process.

The music synthesiser section is based on a Yamaha OPL3 FM synthesiser chip, which uses four-operator FM synthesis to produce 20-voice stereo instrument synthesis, in a way that is fully compatible with the Sound Blaster Pro. The card is also designed to take an optional SP260 'daughter card' which provides PCM 'wavetable' synthesis, to upgrade the synthesiser performance. From the manual it appears that when the daughter card is fitted it takes over the I/O address, IRQ and DMA used for the joystick/external MIDI port.

The manual doesn't specify the output capability of the card's inbuilt audio amplifier, but from the chip used it is probably able to produce about 1.5 - 2W per channel.

It can produce quite a respectable volume from the tiny speakers supplied with the kit, and even more from larger and more efficient speakers.

The card's software-programmed audio mixer has the ability to combine and adjust the levels from six stereo and one mono source.

Its rear mounting bracket provides the usual array of connectors: line audio and mic audio inputs, line audio and speaker

outputs, and of course the 15-pin DB connector for the joystick/external MIDI port.

On the card itself there's the 40-way connector for the CD-ROM drive IDE/ATAPI digital cable, a four-way connector for the audio from the same drive, a couple of DIL pinstrips to mate with the optional SP260 daughter board, and — inevitably! — a number of header strips with jumpers to set the various I/O address, IRQ line and DMA channel options.

Fitting the hardware

Having looked at the CD-ROM drive and sound card as pieces of hardware, then, let's now see how easy or otherwise it is to fit them into the PC.

In the sheer physical sense this is generally not a problem; the CD-ROM drive simply slides into a spare floppy drive bay, and is mounted using the usual pair of screws on each side. You'll probably need to remove the 'blanking plate' from the front of the computer case, to allow access to the front of the drive, but apart from that there'slittle else to do except connect the IDE/ATAPI cable and audio cable to the rear, along with one of the computer's drive power leads.

Similarly the actual *fitting* of the sound card is fairly straightforward, as it's a half-length '16 bit' type and most machines will have a suitable spare slot. About the only possible complication is where your machine is of the 'low profile' type with the plug-in cards mounted horizontally — like the one *we* tried out the RIE kit in. We had to do a bit of card swapping, in fact, because the 'tang' of the sound card's mounting bracket initially clashed with a connector on the tang of the card on the opposite slot...

But the tricky part of the operation actually comes *before* you fit the sound card. You guessed it — this is the part where you have to set jumpers for the various I/O address, IRQ line and DMA channel settings, to ensure that the CPU can communicate with everything without coming to grief. This is the stage where even the experts tend to cross at least one pair of fingers, and not relax fully (or screw the computer's case back on) until they've fired it all up and run a few diagnostic tests.

Surely there are a few basic rules to guide you, in setting up these jumpers? Of course, and in a minute we'll give you a brief rundown.

Just remember, though, that this is the area where there aren't any guarantees; even following all the rules doesn't ensure that you won't strike trouble, in a particular machine with its particular combination of processor, motherboard, BIOS and plug-in cards. It just gives you a much higher probability of success.

The I/O address

First of all, let's consider the matter of

THE IDE/ATAPI INTERFACE

We are grateful to Gary Kicic, chief technician at Rod Irving Electronics, for the following summary of the technical details of the IDE/ATAPI interface and its development:

The dominant hard disk interface in the personal computer market since early 1991 has become the Integrated Device Electronics (IDE) or 'AT-Attachment' type. With an IDE/ATA interface the hard disk drive has all of the necessary control electronics built into it, removing the need for a separate and dedicated controller card to interface the computer's expansion bus to the hard disk (as is required in the ST506, ESDI and SCSI interface standards).

The drive itself, not the cable, determines what drive letter is assigned to it.

The IDE interface does not aim for full plug compatibility with the ISA bus. The drive is interfaced through a 40-pin cable, connecting to the bus either via a 'paddle card' or directly to the mother board. The only function of the paddle card or mother board IDE port is to present only those signals required by the drive — and more importantly, provide buffering. It is not a device controller.

The original IDE specification, which was approved in 1991 by the CAM (Common Access Method) committee, allowed for two physical drives to be attached to one paddle card. All signals from the card were extended to both drives, and jumpering on the drives determined the actions of each. The jumpering set each drive as a 'master' or 'slave', however the master drive is master in name only. It does not control the slave drive in any way, other than to provide the address decoding for both drives in a two-drive system.

All IDE drives can be configured as either a master or a slave. Most are shipped jumpered as a master drive, although some have a neutral jumper position that allows the drive to operate correctly in a single drive system.

The idea of a using a single paddle card to interface two IDE drives was soon extended, to cover the introduction of a second paddle card — to allow up to four drives to be attached to the ISA bus. The second paddle card required a BIOS extension ROM to be fitted so that the PC can recognise more than two drives.

This then resulted in the following IDE options:

Primary IDE paddle port
- Master: Physical drive 1
- Slave: Physical drive 2

Secondary IDE paddle port
- Master: Physical drive 3
- Slave: Physical drive 4

When CD-ROM drives began to be fitted, until recently most of them used either the SCSI (Small Computer Systems Interface) or a proprietary interface. This required yet another interface standard — or in some cases a non-standard one.

With the ever-increasing pressure to reduce the total systems cost, it was inevitable that the question was soon asked: If the IDE interface will handle two drives, and the majority of personal computers only require one hard disk, why can't we interface the CD-ROM drive using the same interface?

It did not take long to provide a solution. An IDE hard disk is required to read and write chunks of data; the job of a CD-ROM drive is even simpler — it is only required to read data, and sometimes audio instead. The audio is taken care of by a separate two-channel audio connector, but control of the data functions of a CD-ROM drive was another matter.

The solution was to come from another committee, the Small Systems Form Factor Committee — in the guise of the ATA Packet Interface or 'ATAPI' standard. The ATAPI was designed to be completely compatible with existing ATA (IDE) hardware and drivers; it changes nothing on the processor side of the AT connection and does not affect the operation of IDE drives. Its correct implementation simply provides manufacturers and programmers with a path to link CD-ROM drives to PCs in a standard way.

Under ATAPI, a CD-ROM drive can replace the slave IDE hard drive in a PC, provided that the hard drive is configured as the master. A CD-ROM drive must however be configurable as either a master or slave, to allow a two CD-ROM system. They are normally shipped configured as a slave.

The ATAPI standard also extended the number of commands required for command and control of ATA devices. This was required for the 'packet' nature of data transfer required by the CD-ROM.

Of course nothing stands still, in the modern computer market. The ATA interface standard has just recently been upgraded to include ATA-2 specifications. In brief this allows for drive capacities of more than 528MB (megabytes) and caters for the higher data transfer rates currently being introduced. Programmed I/O transfer rates up to 11.5MB/s are readily obtainable under ATA-2.

The ATA-2 specification also caters for the IDE paddle card or port having four disks or devices attached. However there is still a requirement for two physical cables, connected to the primary and secondary ports of the interface card.

I believe ATA-3 is currently in the pipeline, with transfer rates of up to 20MB/s and a change to the hardware interface. We live in interesting times!

I/O addresses. As you can see from Table 1, quite a few of the modern PC's range of I/O memory addresses are already allocated to various parts of the system, or 'reserved' for standard add-ons such as serial port adaptors, printer ports, etc. However there *are* some spare addresses available, for things like sound cards and their various functional sub-sections: note the 'gaps' from 0E0 to 0EF, from 100-167, from 208-277, from 280-2AF, from 320-35F and so on.

In principle, then, the idea is to set the I/O address links on your sound card so that its codec, synthesiser, etc., are given addresses in one of these 'free' areas, so there won't be any conflicts or confusion when the CPU tries to communicate with or control them. (Generally the link options are labelled in terms of the different 'base address' settings, where the base address is the *lowest* of the small range of addresses needed.)

This may sound simple enough, but it often isn't *quite* that easy...

For example many sound cards don't give you a huge range of choices, when it comes to choosing the I/O addresses. You often only have two, three or perhaps four at most to choose from, and some of these may be for addresses that are already 'spoken for' in your computer.

Another, more subtle problem is that some plug-in cards (including some sound cards!) don't *fully* decode their I/O address, so that as well as occupying their 'official' address range they may quietly also occupy others. This means that some of the 'free areas' in I/O space may not be free at all, and trying to position your sound card's codec or synthesiser there may still produce unexpected problems.

In general, all you can do is try to match one of the address options that your sound card *does* provide, with a free I/O area in your PC, and give it a try. Then if problems occur, you try another one — until everything seems to work correctly.

Actually there's another consideration as well, and one that can often help you in making the choice. While Windows-based software can generally cope with almost any range of I/O addresses for your sound card sub-systems, a lot of DOS-based software like games simply assumes that you're using a Sound Blaster or SB-clone card, and that it's at the 'default' base addresses used by Sound Blaster: 220 hex for the codec, and 330H for the external MIDI port. So if your sound card jumpers are able to be set for *these* I/O address options, they can be an excellent place to start. Quite often they seem to work well, anyway.

IRQ selection

Now we come to the setting for the interrupt-request or 'IRQ' lines needed by the sound card sub-systems. Each sub-system needs to be allocated its own IRQ line, so that it can indicate to the CPU when it is in need of 'urgent attention'.

As you can see from Table 2, many of a modern PC's complement of IRQ lines are also already used by existing ports or controllers, or reserved for them. On the surface that makes it appear that only IRQ's 10, 11, 12 and 15 are likely to be free for use by your sound card sub-systems. However things are quite often a little more flexible than this.

For example, although IRQ's 7 and 5 are officially allocated to the first and second printer ports respectively, modern printer ports generally use programmed I/O and don't actually use interrupts. So both these lines may well be free, even in computers where there are two printer ports and they're in use. Certainly where there's only only printer port, and no more than two serial ports, it's very likely that IRQ5 will be free.

This is why the usual 'default' setting for the Sound Blaster cards is IRQ5, and again this is generally the best place to start, assuming your own sound card provides this option. If for some reason IRQ5 doesn't give correct operation (not very likely), you can generally try IRQ10, 11 or 7.

DMA channel...

Finally, there's the matter of choosing the correct DMA (direct memory access) 'channel' for your sound card. Generally each of the computer's 'intelligent' peripheral sub-system controllers has to be allocated one of the eight DMA channels, so that it can organise its own high-speed transfers of data to and from memory, via the main address and data busses. They don't always have to be allocated a channel on a totally 'exclusive' basis, but devices which could conceivably want to use the busses at the same time must be allocated different channels, to prevent clashes.

Table 3 shows the usual DMA channel allocations in a modern 'AT' type machine. The main channel 'spoken for' is channel 2, which is always used by the floppy disk controller and is best left for its exclusive use. Although channel 0 is used for refreshing the DRAM memory in XT type machines, it isn't used for this purpose in AT machines, and can often be used.

As before, if your sound card gives various DMA channel options, the idea is to choose one which isn't likely to conflict with any other device controller. The DMA settings for the 16-bit Sound Blasters are channel 1 for 8-bit transfers and channel 5 for 16- bit transfers, and one or other of these is usually a good place to start.

RIE's sound card

The SP300 sound card in RIE's upgrade kit had jumpers allowing it to be set up for the *de facto* Sound Blaster standard settings of I/O base address 220H, IRQ5 and DMA channel 1. (In fact it came with default settings very close to this — we only had to change the IRQ jumper, which was set on IRQ7.) So we used these settings, and they turned out to be fine for the 486/66MHz computer in which we installed the kit.

The card also had an enable/disable jumper for the on-board CD-ROM drive IDE/ATAPI port, which was already set to 'enable' so we left it that way. The port appeared to be fixed at the 'IDE/

Table 1: I/O Address assignments (AT)

Address (hex)	Used by
000-01F	DMA controller 1
020-23F	Interrupt controller 1
040-05F	Timer
060-06F	Keyboard/Mouse controller
070-07F	Real-time clock, NMI mask register
080-09F	DMA page register (80 = POST code port)
0A0-0BF	Interrupt controller 2
0C0-0DF	DMA controller 2
0F0-0FF	Maths coprocessor
168-16F	IDE/ATAPI port 4
170-177	IDE/ATAPI port 2
1E8-1EF	IDE/ATAPI port 3
1F0-1F8	Hard disk (IDE/ATAPI port 1)
200-207	Game I/O (Joystick/MIDI)
278-27F	Printer port LPT2: (LPT3:)
2B0-2DF	EGA/VGA video adaptor (alternate)
2E1-2E3	Data Acq/GPIB Adaptor 0
2E8-2EF	Serial port COM4:
2F8-2FF	Serial port COM2:
300-31F	Prototyping card
360-36F	Network adaptor
378-37F	Printer port LPT1: (LPT2:)
380-38F	SDLC/Bisync adaptor 2
3A0-3AF	Bisync adaptor 1
3B0-3BF	MDA video adaptor, printer port (LPT1:)
3C0-3CF	EGA/VGA video adaptor
3D0-3DF	CGA video adaptor
3E8-3EF	Serial port COM3:
3F0-3F7	Floppy disk controller

ATAPI port 2' base address of 170H, with IRQ15 for its interrupts, and this didn't clash with anything else.

Another jumper was identified as 'CD-ROM I/O Channel Ready', but was set by default to the 'disabled'. The exact purpose of this jumper is a little vague; it seems to be used by slow CD-ROM drives to introduce additional wait states for the CPU, if they can't keep up. We left the jumper in its default position, and everything turned out fine...

We did have one minor hassle with three other jumpers on the SP300 card, however. These were described as selecting either the internal or external MIDI port, and the manual seemed to indicate that to use the external port (which we wanted), they had to be set to the 'MPU-401' positions.

We did this, but later discovered that this was wrong; the external MIDI port remained 'dead' until we swapped the jumpers back to their default 'SB- MIDI' positions. It wasn't a major drama, but things would have been easier if the manual had been clearer and/or correct.

Software setup

Once you've set the sound card's jumpers, fitted it into the computer and attached the cables to the CD-ROM drive, the final step is to install and setup up the matching software. This is generally done in two stages: installing the 'driver' routines so that DOS, Windows and their applications programs are able to locate and communicate with the sound card and CD-ROM drive, and then installing any applications software that may come with the sound card — music player programs, and so on.

With the RIE upgrade kit there were three floppy disks in all — two with drivers and applications for the sound card, and one with the driver for the CD-ROM drive. The sound card software came with its own INSTALL.EXE program, while the CD-ROM driver had its own SETUP.EXE program. Both installing programs ran under DOS.

We struck a couple of minor hassles during the installation, as it happens. Initially INSTALL.EXE ground to a halt, proclaiming that it couldn't copy a file called THREED.VBX to the hard disk. It turned out that because our machine had *Windows for Workgroups 3.11* installed, the file concerned was already on the hard disk, and INSTALL.EXE didn't seem to know how to cope with this eventuality...

We solved this one by renaming the existing THREED.VBX, and trying again. This time INSTALL.EXE was happy, and installed all of the sound card software with no further problems. We checked later to determine the version of THREED.VBX with the later date, and this was the version we elected to use.

Table 2
Basic IRQ assignments (AT)

IRQ line	Assigned device
IRQ0	System Timer
IRQ1	Keyboard
IRQ2	(Used by controller for IRQ8-15)
IRQ3	Serial port COM2: or COM4:
IRQ4	Serial port COM1: or COM3:
IRQ5	(Printer port LPT2: or LPT3:)
IRQ6	Floppy disk controller
IRQ7	(Printer port LPT1: or LPT2:)
IRQ8	Real time clock
IRQ9	BIOS
IRQ10	(Network adaptor)
IRQ11	(Available)
IRQ12	(Available)
IRQ13	Maths co-processor
IRQ14	Hard disk controller
IRQ15	(Available)

The other hassle was with the CD-ROM software driver installer SETUP.EXE, which simply wouldn't run on our machine — perhaps because it was running Novell network software. Anyway, we found from a README file on the floppy that all SETUP.EXE was supposed to do was copy over the CD-ROM driver (called VIDE- CDD.SYS) to the hard disk, and add a line into our CONFIG.SYS file so that it's installed into the system during boot-up:

DEVICE=VIDE-CDD.SYS
/D:MSCD001 /P:170,15

where the '/P:170,15' switch on the end is to tell the driver where to find the CD-ROM drive, at I/O base address 170 and using IRQ15. So we did these operations manually, and everything turned out to be fine.

The end result

When our basic installation was complete, I tried installing and running a couple of applications programs to test the computer's newly acquired multimedia capabilities (and also make sure that there weren't any clashes).

Table 3
DMA channel usage

Channel 0	DRAM memory refresh (XT)
Channel 1	(Available - 8 bit)
Channel 2	Floppy disk controller
Channel 3	(Available - 8 bit)
Channel 4	First DMA controller
Channel 5	(Available - 16 bit)
Channel 6	(Available - 16 bit)
Channel 7	(Available - 16 bit)

One package was the very nice MIDI Music Sequencer package *Powertracks Pro*, which I've found to work very well with my Kawai G-Mega synthesiser module, connected via the MIDI Breakout Box I described in the February 1994 issue. This was when I discovered the problem noted earlier, where the external MIDI port wouldn't work with the sound card jumper settings given in the manual. Swinging the jumpers back solved this one, though, and *Powertracks Pro* happily played MIDI files out through the Kawai G-Mega, and accepted input from a MIDI keyboard.

On the advice of RIE's chief technician Gary Kicic VK3TOV, who is very experienced in the business of building up and debugging modern PC systems, I also tried installing and running Microsoft's *Encarta 95*, directly from one of the CD-ROMs supplied in the kit. Gary tells me that *Encarta* is a very good benchmark, because if your system has any subtle clashes it either won't install, or won't run correctly.

As it happens, *Encarta 95* both installed and ran on the system without any problems.

So after trying it out for a while (it's a most impressive package!), I was able fit the cover back on the computer, and pronounce its upgrade 'operation' as complete. As you can see, although installing one of the current 'multimedia upgrade' kits is somewhat easier and less problematic than it has been in the past, there can still be a few minor complications. It pays to have a reasonably clear understanding of what you're doing, as this will allow you to sort out any of these complications when they occur.

Hopefully the information given in this article will help you you carry out this job with a high probability of success.

My grateful thanks to Gary Kicic of Rod Irving Electronics for his assistance in preparing the article, and also to Rod Irving himself for suggesting that an article along these lines would be a good idea, and prompting me to do it by sending a typical kit.

Needless to say, if you've been encouraged by the article to 'give it a go' and upgrade your own computer, you'll find a range of suitable kits in RIE's stores. You'll find the addresses in their advertisements. ❖

ELECTRONICS AUSTRALIA'S READER INFORMATION SERVICE COMPUTER BULLETIN BOARD

As part of its service to readers, *Electronics Australia* operates a Reader Information Service Bulletin Board System (BBS). This makes available a wide range of useful information, for convenient access and rapid downloading by readers with a personal computer and modem (we know that many readers have these facilities, nowadays).

Here's an idea of what's currently available on the BBS:

- Software needed for recent PC-based EA construction projects
- Project index files for EA and ETI construction projects
- Recent notes and errata
- Useful public domain and 'shareware' software for electronics and amateur radio applications
- General interest shareware utilities, such as the compression and decompression utilities used for faster file transfer.

The *Electronics Australia* Reader Information Service BBS is ANSI-compatible and is currently operational for virtually 24 hours each day, seven days a week, on (02) 353 0627. Your modem can be set to any standard speed from 300 to 28,800b/s full duplex, with a data format of '8-N-1' (eight data bits, no parity and one stop bit).

We're planning to increase the range of facilities available on the BBS soon, by adding such things as a discussion forum and a more convenient way for readers to send us 'Letters to the Editor' and contributions to columns like Forum and Information Centre...

So call up the *Electronics Australia* BBS and take advantage of its facilities — there is no cost for accessing the system itself, which is provided purely as a service for our readers. Your only outlay will be the usual cost for a phone call.

Note that for those readers without a modem, we can still supply project software and/or index files for $5.00 if you send us a formatted high density 3.5" or 5.25" floppy disk.

READER INFO NO. 3

READER INFO NO. 4

AUSTRALIAN

SMALL BUSINESS

& PORTFOLIO

All too often small business can get lost and drowned in a sea of bookkeeping, customer problems and debts. The smart ones always turn to *Australian Small Business & Portfolio* magazine.

This magazine allays your fears and prepares you for the unexpected.

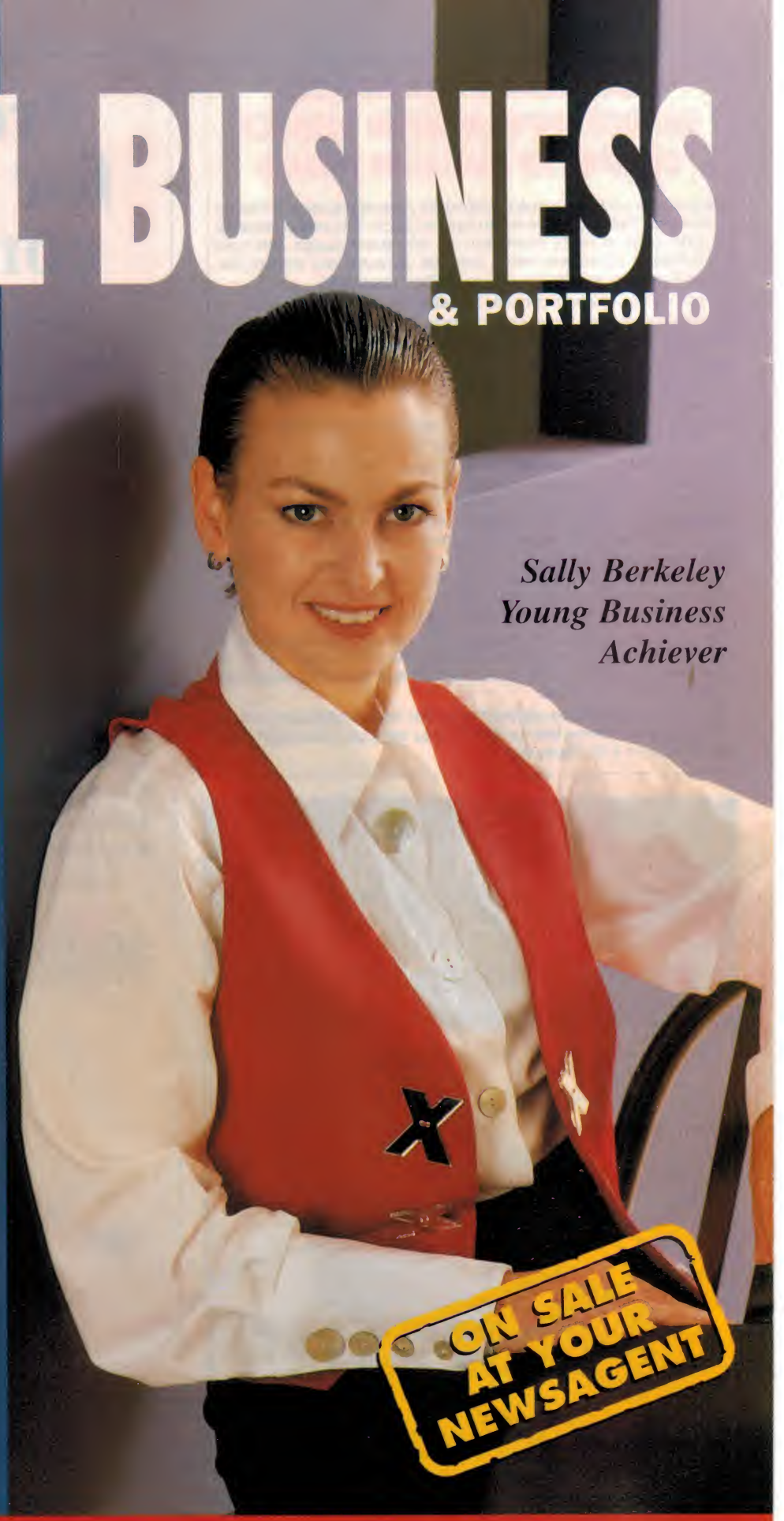
To subscribe to *Australian Small Business & Portfolio* magazine phone

TOLL FREE 008 800 933

Sydney residents phone (02) 353 9992 and have your credit card details ready.

Or send your name, address and phone number, with your payment of $53 for 12 issues (cheque, credit card details or money order) to:

Federal Publishing,
Subscriptions Department,
Reply Paid No. 3,
PO Box 199,
ALEXANDRIA NSW 2015.
(No stamp required)
or fax (02) 353 0967.



Don't do business without it!

WE'LL SUPPLY THE

MUG

IF YOU SUPPLY THE COFFEE

SUBSCRIBE NOW!!!

TO GET YOURS FREE

To have *Electronics Australia* magazine delivered to your home or office subscribe or extend your subscription for only $53.00 (which includes postage and handling charges) **THAT'S A SAVING OF 10% OFF THE COVER PRICE.**

Plus if you subscribe before June 20 1995, you will also receive the *Electronics Australia* coffee mug valued at $9.95 each

HURRY OFFER ENDS JUNE 20, 1995

Any queries about your subscription? Phone our customer service line: (02) 353 9992

To subscribe by credit card phone **TOLL FREE 008 800 933**
- **Sydney residents phone (02) 353 9992.** Or fill in the subscription card attached and send with your payment (cheque, credit card details or money order) to:
Federal Publishing, Subscriptions Department,
Free post No 3, PO Box 199,
ALEXANDRIA NSW 2015
(no stamp required) or
fax (02) 353 0967.

ELT/000/MUG 4,5,6/95

AUTOMOTIVE ELECTRONICS

with NICK de VRIES MIAME, AMSAE, FI Diag.E.

Using a scope for vehicle faultfinding — 2

In my last column we started to look at the use of a lab scope in an automotive capacity, and this month we will explore this concept further. I am including some prints of waveshapes captured with a digital scope, to make things clearer. (Funny how the digital scope comes in so handy to illustrate an analog waveform!)

Carrying on with my theme of 'input signals', it seems (themes?) to be a good idea to mention a few of the more common waveshapes that the automotive technician has to be familiar with. Having promised to show you 'how to make sense of the squiggly lines', Fig.1 is a breakdown of the 'coil negative' signal for a traditional Kettering system, highlighting the segments of interest.

To include a view of even the more well-known faults that afflict the Kettering system would take several pages of illustrations and explanations, so I hope you will manage for now with just knowing what a good signal looks like.

With new developments in ignition coil design and manufacture, the coil negative or 'primary' waveshape has changed some of its basic characteristics.

Notably, the 'ringing' effect or oscillations have all but disappeared. Fig.2 shows, at 20 volts per division, the waveshape of a Ford EB fitted with a 'Transformer' coil (they were always transformers, but it sounds like a trendy name!); as you can see, aside from the different trigger point, there are significant differences from the waveshape in Fig.1.

Coil positive wave

Those of you who have had some training in electronics may recognise the characteristic inductor charge-up waveform displayed in Fig.3, taken from the coil positive terminal. Only contact-breaker type ignition systems fitted with a ballast resistor in series with the coil will have this type of wave — all other systems have the coil strapped to battery positive through the ignition switch.

If you are using a dual-trace scope on this and the coil negative signal, try triggering the sweep off the rising edge of either input in 'chopped' mode, to observe the timing relationship of the two signals.

The instant just before the coil is fired is the point where maximum current is drawn; to test for voltage drop in the switching circuit, measure the height above ground of the coil negative trace at this point, it should be no more than 0.3V.

Electronic ignitions have a variety of waveshapes, depending on the type of

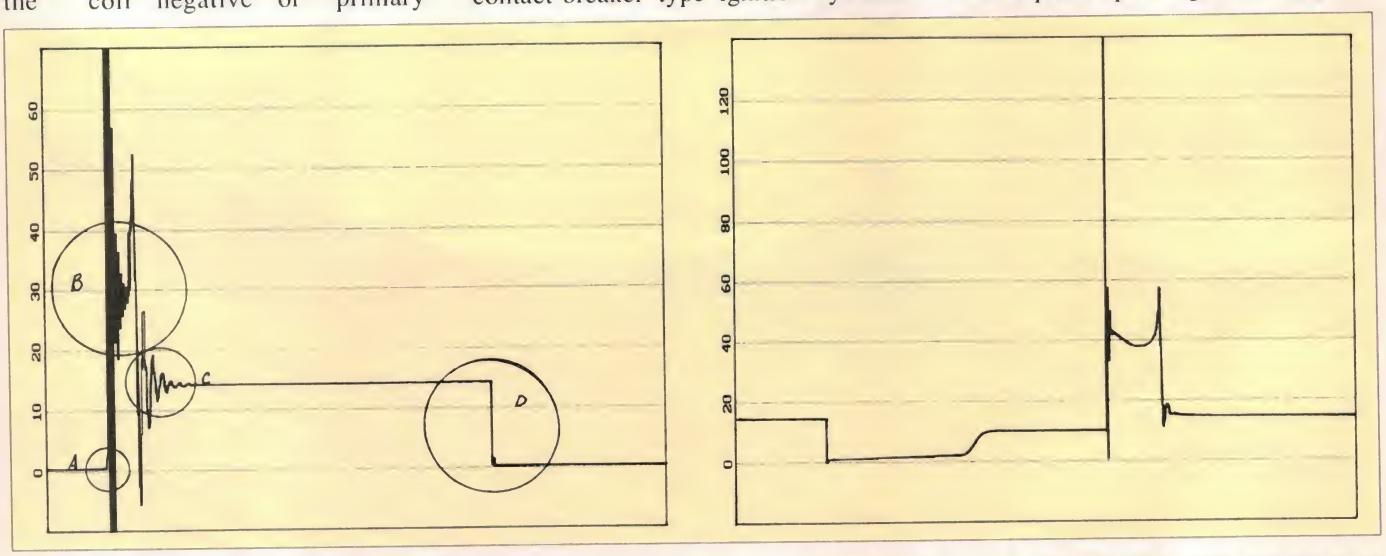


Fig.1 (left): The 'coil negative' signal of a traditional Kettering ignition system, with features of interest identified. A is where the points are opening, look for hash or arcing; at B are the primary coil oscillations, gradually decreasing over approximately 1.5ms; at C are the coil/condenser oscillations, where the coil energy dissipates down to system voltage; and finally D is where the points close again. This should be a clean switch down to ground. Fig.2 (right): Decades after Dr Kettering, we see here a very clean and hash-free primary ignition signal from Mr Ford. In fact, it's an EB Falcon six cylinder, with variable current control instead of a ballast resistor and thick film transistors instead of contact breakers.

current limiting used and the voltage at this same point will vary from 0.6 volts (one transistor) to about 9.6V with current limiting.

Purpose-built automotive scopes sometimes make this measurement for you and display a digital value of the reading just to make things easy; but as we are doing this with a general purpose scope, we'll have to persevere doing things manually.

Another common although little understood signal (from a testing point of view) is the oxygen sensor output. In the March edition of *EA* I included a snapshot of an oxygen sensor output signal, when the throttle was being oscillated between closed and about 50% open as rapidly as possible to observe the full scale transition and speed of the sensor.

In the interests of saving space, trees and ink, I'll leave the illustration out this time; however, the principle here is that the voltage ranges between zero and one volt depending on fuel mixture strength, and it also does it in a reasonably rapid manner.

The sensor in my VL Commodore measures about 80ms rise (lean to rich) and 40ms fall (rich to lean). A sensor that is 'dying' might take 150ms to fall from maximum rich to lean, which is much too slow when you consider how fast things are happening in the combustion chambers.

Knock sensor

On to another rare gem from the blurred category I alluded to in April's column under 'input signals'. Fig.4 shows the output of the knock sensor, caught in the act of 'hearing' a severe knocking or detonation in an over-advanced ignition timing condition. This is the familiar 'marbles in the cylinders' sound, often heard when inattentive drivers forget to change down a gear to drive around a corner.

The promise of technology in this application is that, providing the sensor is placed in the appropriate spot in the engine block, the signal is sent to the ECU at the onset of engine knock.

The ECU responds by retarding the ignition timing (or firing point of the next ignition cycle) by about two or three degrees, and gradually restores the full advance over a period of engine cycles.

If the engine is of a quiet enough design, with well-damped cam chains and hydraulic rocker arms, the ECU can be tuned to only retard the firing point on the offending cylinder, rather than a blanket 'all cylinders' approach. Some engine designs use this function, but I suspect that it is somewhat difficult to achieve with any sort of reliability in an overhead camshaft engine.

I believe some of the more exotic offerings from Europe have one knock sensor per cylinder, in an attempt to provide the maximum amount of advance possible for each cylinder and therefore not sacrifice too much power when fuel quality — for example — is not quite up to scratch.

At an Adelaide SAE meeting in February this year, guest speaker Ken Stanford, an engineer with Ford Motor Co., gave us an interesting snippet about knock sensor operation.

In the new EF series six cylinder engine, to eliminate any confusion in the ECU, it only 'listens' to the knock sensor when it is approaching the correct phase of the engine's ignition cycles. This blocks out any unwanted goings on at a similar frequency (7kHz), to prevent them from influencing the ECU unnecessarily.

Variable voltages

Now it's time to look at some signals from the 'Category Two' variable voltage group. This group contains only analog signals, with no timing implications whatsoever.

Fig.5 is the output from an air mass meter, with the engine accelerating from idle to high speed over a period of about 900ms. The initial surge is used by the ECU to calculate acceleration enrichment, similar to the accelerator pump in carburettors. Although the signal drops back to just above the idle value, the engine speed takes quite a bit longer to return to idle.

It would be nice to show you the acceleration and deceleration curves superimposed on this picture, but I don't have a tacho with a suitable analog output to use as a 'B' channel input. Does anyone have a circuit for such a device?

Here's a question, regarding the AMM signal of Fig.5. I haven't yet come up with a reason for the oscillations in the high speed range, perhaps someone can enlighten me?

The oscillations in the low speed end of the curve I'm happy to attribute to pulsations in the inlet manifold, the amplitude of which smooths out after the engine speed increases by about the 300ms mark, and the in-coming air stream becomes one continuous draft.

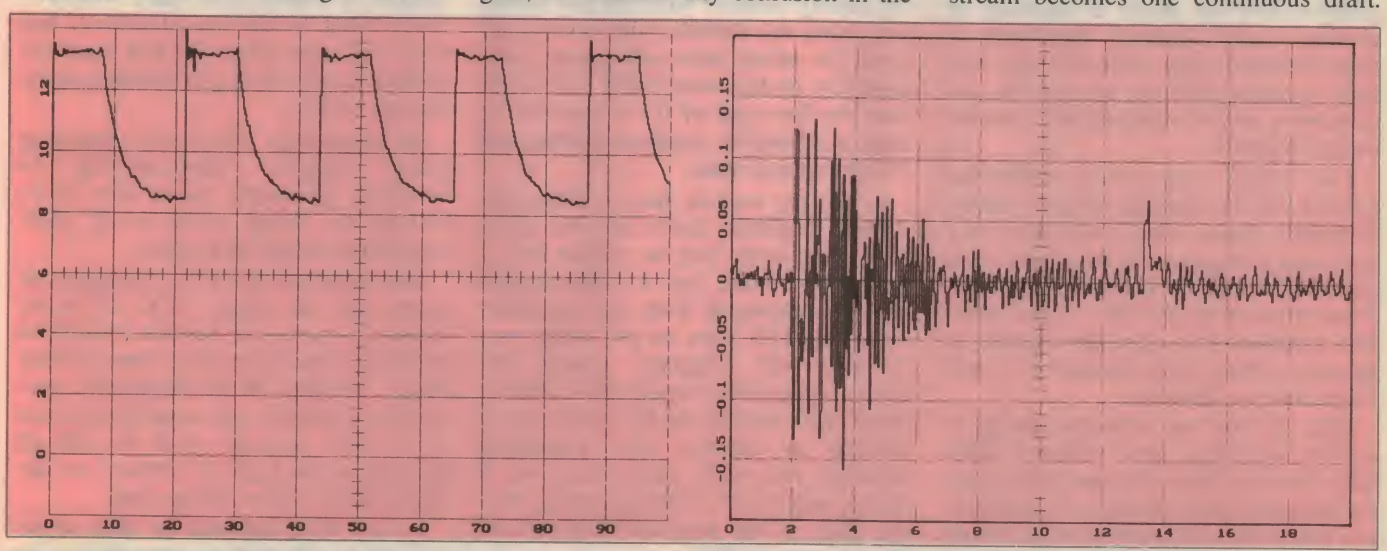


Fig.3 (left): The coil positive signal in a 'ballasted' Kettering system. Your DMM won't show this sort of detail... Fig.4 (right): Who's that knocking at my door? A knock sensor in full voice, care of an Audi in need of premium unleaded fuel. Your DMM definitely won't show you this, either!

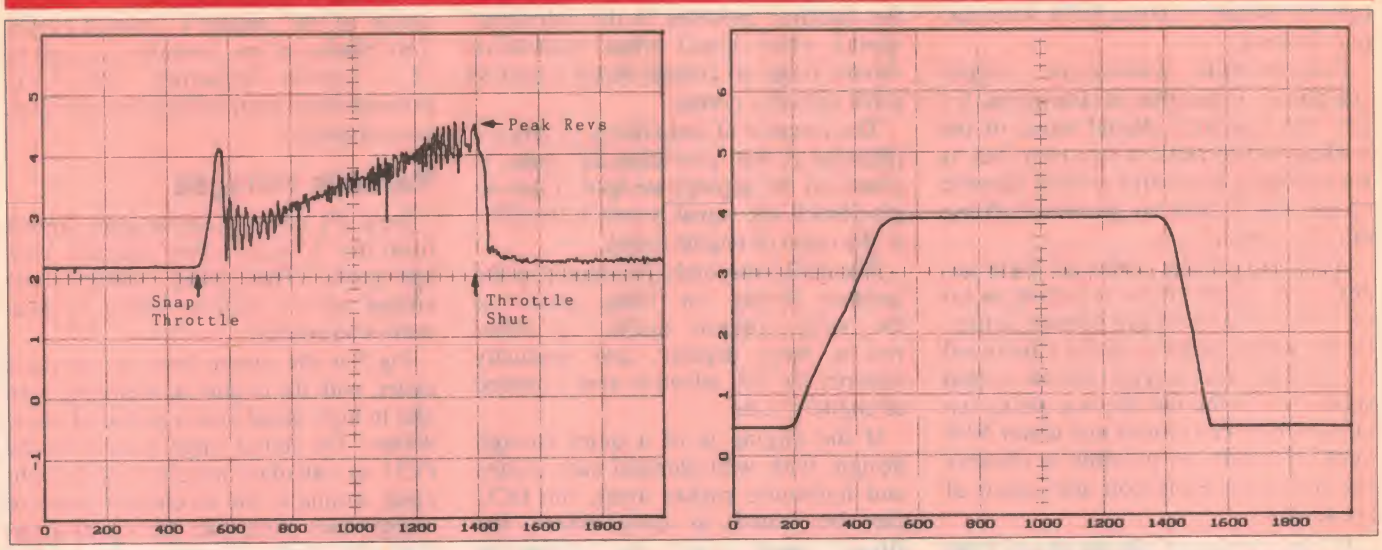


Fig.5 (left): An air mass meter with a problem? The engine was accelerating from idle to high speed over about 900ms. Note the oscillations, dying away and then building again as the engine revs increase. Can anyone explain what causes them? Fig.6 (right): Is the output from your throttle position switch as clean as this? This one isn't quite adjusted correctly, though.

But what's happening at the peak revs end?

Drop us a line, or give me a call on (085) 63 0607. Perhaps you have an idea what's going on, or maybe you would like to see an article devoted to a particular aspect of Automotive Electronics in a future edition...

Throttle sensor

An important function to test in EFI vehicles is the quality of the throttle position sensor (TPS) signal. There are three types that I am aware of; the early 'D' Jetronic EFI systems employed a type of grid and wiper switch, to give a digital signal that indicated both throttle position and the speed of opening or closing. Later systems employed a three-terminal type with idle and full load contacts built in, leaving the air flow/mass meter to determine acceleration enrichment.

The current crop of motor vehicles tend to use the variable resistor variety of throttle sensor, which must be set to a particular voltage at idle by means of an adjustable slotted clamping bracket. From this sensor the ECU determines idle position, how fast the throttle is opened ('struth, he's floored it!'), and the position at all times.

Most drivers use a limited range of throttle openings, and vehicles fitted with cruise control that are often used for long trips may develop a 'wear spot' at a particular load/speed position. From a servicing point of view there is little mileage in trying to repair the microswitch types, however it is sometimes possible to extend their life by judicious applications of 'contact cleaner'.

Triggering your scope to capture the signal from the variable resistor type of TPS 'on screen' long enough to critically inspect the waveshape is quite a ticklish little problem with an analog scope, and this is where the digital storage scope really shines.

Even so, it took me a couple of attempts to catch the trace crossing the screen at just the right moment and end up with the trace central in the screen (Fig.6).

If you set the trigger point for a rising edge on the external trigger input, and touch the probe for the trigger input on the battery positive terminal just before you open the throttle with your other hand, the sensor trace will appear fairly centrally on the screen and you won't lose the first part of the rising edge. I used a 200ms/div timebase setting and 1V/div vertical scale.

A tip: my vehicle has an electronic voltage regulator built into the alternator, and with 'key on engine off', I could just make out a high pitched squeal emanating from the regulator area. The TPS trace on the screen was covered with regularly spaced AC spikes about 50ms apart and 0.25V in amplitude, similar to the hash you're hoping to see/not see, depending whether you make your living out of fixing motor cars. Unplugging the two-pin plug to the regulator restored the trace to smooth DC.

Things to look out for are 'hash' at the beginning and end of the TPS trace where the throttle sits at idle, and also at the lower end of the rising and falling edges of the slopes where you would expect the throttle to spend most of its working life.

Now that I'm looking at the printout of Fig.6, I've just realised that the sensor isn't quite set correctly! The closed voltage should be 0.5 - 0.9V and the fully open voltage should be 4.0 - 5.0V. I'll be back in a minute, after I fix it...

Back again, and it's time for some philosophy. I hope you are beginning to realise the importance that the oscilloscope is playing in diagnosing customers' complaints about their motor cars. The digital multimeter or 'DMM' is a great tool and I wouldn't know what to do without mine, but there are some jobs you just can't do without a CRO or digital storage oscilloscope (DSO).

As technology brings new and ever more complex enhancements to everyday affordable motor cars, technicians are being asked to lift their capabilities higher and higher.

One approach is a list of voltages for every pin on every ECU of every variety of motor car, but this is likely to produce technicians who cannot think things through to a diagnostic conclusion. I feel the only sensible solution is to train yourself, with the aid of equipment that helps to promote an understanding of how things work.

In my final episode in this scope series, we will look at some ECU output signals and how the ins and outs interact. ❖

Your Computer is Australia's only computer magazine written for small business and home users.

Our editorial is locally written and is slanted with a 'hands on' approach for those who believe in PCs as a tool to increase business efficiency and productivity. As it says on our cover we've been Helping PC users since 1981.

To subscribe to *Your Computer* magazine phone TOLL FREE 008 800 933 - Sydney residents phone (02) 353 9992 - and have your credit card detail ready. Or send your name, address and phone number, with your payment of $53. for 12 issues (cheque, credit card details or money order) to: Federal Publishing, Subscriptions Department, Reply Paid No. 3, PO Box 199, Alexandria NSW 2015 (no stamp required) or fax (02) 353 0967.

ON SALE AT YOUR NEWSAGENTS NOW

Talk to the company that can provide for your needs Australia wide.

MELBOURNE SATELLITES

■ **Ku BAND - OPTUS $995.00**
1.5m Andrew antenna, AzEl mount, dual polarity LNBF, 200 channel Echostar I/R remote satellite receiver, 25m RG6U coaxial cable.

■ **C BAND - PANAMSAT $995.00**
1.8m prime focus ground mount antenna, dual polarity LNBF, 200 channel Echostar I/R remote satellite receiver, 25m RG6U coaxial cable.

■ **C & Ku BAND - MOTORISED $2499.00**
2.3m KTI mesh polar antenna, C/Ku combined feedhorn, 2 x LNB's, 12 inch jack, Echostar I/R jack controller, and low threshold 2 1F input satellite receiver, RG6U coaxial cables, and control wires.

NEED MORE INFORMATION?
Phone, write or fax OR
Use our ***new fax information**** *service*
on (03) 738 0590 (from your fax machine)
* Contains: full product range, specifications, transponder list, what's new, etc.

MELBOURNE SATELLITES
82 BAYFIELD RD. (PO BOX 901) BAYSWATER, VIC. 3153
PH: (03) 738 0888 FAX: (03) 729 8276

READER INFO NO. 6

Moffat's Madhouse...

by TOM MOFFAT

A little slice of heaven, in Denver

Compulsory formal qualifications or not? That's the big debate in the electronics servicing industry at the moment. In this magazine it started in the Serviceman column (pardon me — shouldn't that be 'Serviceperson'? Let's get our political correctness correct! Just kidding). Anyhow the whole issue seems to have migrated to the Forum area (which is what Forum is for, after all...), where the sparks have been flying from all directions.

I particularly liked the cartoon in the February issue showing Jim Rowe jousting with his pen against a 'hornet's nest' full of service technicians. All of them looked very angry, with stingers drawn. Well, maybe I'll join in now; I'll go up and give that hornet's nest a good swift kick and then run like hell. That's what you call living dangerously.

There are two distinct sides to the argument as I see it. Technicians already within the service industry want any newcomers to have 'qualifications', before they are allowed to enter the industry themselves. This, on the surface of it, looks like the traditional 'closed shop'. On the other hand, we wouldn't want complete charlatans attacking somebody's video recorder or big expensive TV and making a total mess of it. Everybody out there knows this can occur — "let's just tweak this thing and see what happens".

It seems a big part of the issue would be just what is being serviced. If a complete inexperienced dolt attacks someone's VCR, there's just one victim — the owner of the VCR — and nobody else. But what about the same dolt trying his hand at something like a CB radio? "Let's just tweak this and see what happens", and 'this' is one of the alignment controls for the transmitter's linear stages. Then the CB goes bonkers, splattering and emitting rubbish all over the band. Now there are lots of victims — everyone who is trying to receive on one of the nearby channels.

All this is leading up to my own technical training many years ago in the USA, and the 'formal qualification' resulting therefrom. The situation in America was, and probably still is, that anyone could fix a radio receiver or a TV set or a stereo or anything else, with no piece of paper required. If you wanted to go into the servicing business, you just hung out your shingle and went for it. If you were a fool, you only affected the owner of the device and nobody else. But such shoddy practices could draw the attention of the Better Business Bureau, and you might find yourself out of business quick smart.

If, however, you wanted to go into servicing two-way radios, or anything at all that could transmit a signal, then you HAD to have a licence issued by the Federal Communications Commission. This meant a stint at some kind of tech school, followed by a horrendous examination administered to trembling candidates in one of the FCC's regional offices.

I got involved in this scene while working for the Bell Telephone Company. I wangled my way into a job working on microwave radio relay gear, but since this stuff contained transmitters (of a screaming 100 milliwatts or so), I couldn't touch it without the government licence. So it was off to the American Telephone and Telegraph Company's technical training college in Denver, Colorado.

The course was broken up into two parts. 'B1A School' ran for five weeks and covered fundamentals of electricity more than electronics — volts and amps and watts, and big batteries and generators and current flow through wires and all that stuff that makes a telephone exchange tick over.

We were then sent back to our home towns to let this learning sink in. Those going on into radio were brought back to Denver a few months later for the six-week 'B1B School', where we got stuck into electronics proper.

At the end of B1B School we were all herded off to the Denver FCC office to sit the exam for 'Second Class Radiotelephone Operator's Permit'. This licence would allow you to work on microwave stuff, as well as VHF and UHF two-way radio gear. In other words, line-of-sight equipment only.

It was also possible, with a certain amount of after hours self-study, to go for the big one — the 'First Class Radiotelephone Operator's Permit'. This allowed you to work on HF radio gear with world-wide range. You could also be employed as Chief Engineer in a radio or television station, and, with a 25 word-a-minute Morse Code endorsement, you could become a ship's radio officer.

Well, that sounded pretty good to me. Even though it was the highest technical qualification issued by the US government, and damn hard work, I went for the 'First Class Ticket' and won. It was well worth the trouble; I got onto the Telephone Company's mountain-topping microwave crew straight away, and also landed a job as night engineer in a radio station. A First Class ticket was required here because the station used a directional antenna system at night.

A lot of people groan about being forced to get technical qualifications, but I found the whole experience to be jolly good fun. Each class had about 20 students, and Ma Bell had permanently booked out the first two floors of the nearby Olin Hotel as accommodation. One of the big airlines had a similar arrangement for the next two floors, as overnight accommodation for their flight attendants. Get the picture? The Olin Hotel was a little slice of heaven!

The fifth floor was the permanent residence of several little old ladies, well separated from a rather lively disco in the basement known as 'The Cave'. On the Olin's ground floor was a bar of a more romantic nature, presided over by a lovely black woman piano player. So one could make contact with a likely

member of the opposite sex in The Cave, and then migrate to the piano bar if things got interesting. In the first week I was there, this arrangement connected me with a smashing six-foot blonde named Barbara Sims, who eventually accompanied me through both the B1A and B1B schools, as well as some visits to Denver in between. I wonder whatever happened to her?

One great feature of the Bell tech school was the lab. Mornings would be nose-down in the textbook getting the theory, but after lunch the whole class would move into the lab to put into practice the things learned in the morning. As well as the usual voltmeters and ammeters, the lab even had things like Lecher Lines — so you could see the results of standing waves on a transmission line, as well as read about them. Practical experimentation was encouraged in every way.

Lab activities even extended to the Olin Hotel. On warm evenings after class we would head up to the roof with a case of beer, to soak up the last rays of the sun. Also on the roof was this little hut from which emitted interesting clicks and clacks and humming noises. We soon discovered the hut contained the driving motors, as well as the control circuitry, for the hotel's one ancient elevator.

As the car would move up and down, we observed that many relays and solenoids would open and close. We also observed that you could make the lift do your bidding if you manually operated certain relays with a stick. Thus, with some carefully thought-out relay poking, we could send one of the little old ladies to the third floor, instead of the ground floor she had selected. Or one of the airline hosties could be diverted to the fifth floor to join the little old ladies. Or better still, we could send a whole elevator-load of hosties to the Telephone Company floor. Mind you, these activities were only to further our technical knowledge...

Yes, we became regular elevator experts. There was an enormous lift in the office building where our classroom was located; the thing could carry the entire class of 20 at once. We soon learned that this lift was vulnerable too. If all 20 class members jumped up and down in unison as the lift was coming in to land at the ground floor, we could make it overshoot right down to its springs at the bottom of the shaft. When the doors opened we would climb up to the floor at about knee height, leaving the disabled lift for the building's maintenance people to investigate. They never did work out what happened.

We all got along famously with the Olin Hotel's piano player, mostly because there was a gift of flowers from the 'telephone boys' every night when she arrived for work. Little did she know that the flowers had until recently been resident in the grounds of the Colorado State Capital building, which we walked past every evening.

Speaking of the Capital, it was the subject of yet another technical exercise for the Bell tech school. The Capital was built back in the gold rush days, and the State of Colorado decided to show how prosperous it was by covering the building's dome with solid gold leaf. Gold leaf is pretty thin stuff, but it was an enormous dome. And the view from the guest lounge at the Olin Hotel was dominated by that dome, only one block away.

We would sit there, having a few after-dinner drinkies, and somebody would say "How are we going to get that gold?" Just an academic exercise, you understand, but many screwball schemes were thought up — such as winding coils around the dome and melting the gold with induction heat.

A more direct approach involved climbing up there in the dead of night and simply ripping it off. Readers will be comforted to know that, as of December last year, the gold was still intact. Anybody got any ideas?

As for the Olin Hotel, years of makin' whoopee by the telephone guys and the airline girls and the little old ladies seem to have taken their toll.

Nowadays The Cave is gone, and somebody has even filled in the swimming pool. The hotel has been taken over by the US government's Department of Housing and Urban Development (a bit like our Housing Commission), and it's now a permanent home for disabled and unemployed people. I do hope some of the charm of the place is still there for them to enjoy.

As for the Bell Telephone technical school, I suppose it must still exist somewhere, because all those radio people still gotta get their qualifications. I just hope the school is as good for them as it was for me.

It's interesting to note that when I migrated to Australia back in 1968, the Government here didn't want to know about my First Class FCC ticket. If I wanted to work as an engineer in a radio or TV station, I needed a 'Television Operator's Certificate of Proficiency'.

After reading through the syllabus, I thought I'd have a pretty good chance of passing the exam, after learning such things as new TV receiver intermediate frequencies. Otherwise it seemed to be pretty much the same as my FCC ticket. But no, you couldn't just walk in and sit the exam. You had to attend an *Australian* tech school first. It had that definite ring of 'closed shop' about it...

If the situation comes about where formal qualifications are needed to work as a technician, there's really nothing to fear. You DO learn something — not everything, mind you, but the theory and practice you absorb will be of considerable value for the rest of your working life.

But, as many people have pointed out in the ongoing debate, none of this schooling is really much chop without genuine hands-on experience. Hopefully on the COLD end of the soldering iron! ❖

BIG SCREEN 3D TV NEEDS NO GLASSES

Perth-based firm Xenotech Australia has developed a novel and patented projection 3D system which requires no special viewing glasses or filters, and is attracting interest from around the world because of its potential applications in 'virtual reality' computer displays, training simulators and arcade games. Already the company has signed a million dollar international licence agreement with Korea's Samsung Electronics, one of the world's largest manufacturers of TV receivers and computer monitors.

by JIM ROWE

Although a relatively new company, and still not very widely known other than in Western Australia, high technology developer Xenotech Australia has already attracted quite a lot of international interest for its innovative 'no glasses' 3D projection TV system.

After testing the Xenotech system, Korea's electronics manufacturing giant Samsung Electronics proclaimed it better than anything it had previously tested, and last October the firms signed an international licensing agreement whereby Samsung is paying an initial $1 million to fund further development, and will pay substantial royalties when the technology is used in its products.

The agreement with Samsung is non-exclusive for all territories other than Korea, leaving Xenotech free to negotiate further licence agreements for other countries.

And judging from the interest attracted by the technology, further announcements are certainly anticipated in the near future. All of which is quite impressive, for a company which was only established a little over two years ago.

So how did it all begin? Well, the technology itself is the brainchild of Xenotech's research director Angus Richards, a young engineer who majored in robotics imaging when he graduated from Curtin University in 1988, winning the Don Watts Prize for his final year project.

About four years ago, Mr Richards became interested in large-screen 3D displays after inspecting a large-screen arcade game. After building and testing a series of prototypes, he came up with a system which worked well enough to demonstrate it to investors. A group of Perth businessmen and investors were then sufficiently impressed to back his research, and in early 1993 Xenotech was established.

Since then the company has expanded its operations at Osborne Park in Perth, and has also opened an international head office in Calgary, Canada. Mr Richards himself now controls Xenotech Research, while Xenotech Australia handles the commercialisation and licensing of the technology, under the control of CEO Mr John Ripp. The international operations are known as Xenotech Inc, with Angus Richards as President and UK-based Mr Neil Speakman as Chairman.

Xenotech Inc is in fact a public company listed on the Alberta Stock Exchange, with shares held by Mr Richards, Mr Speakman, the original Australian investors and a major institutional investor. The two Australian firms are its wholly owned subsidiaries.

Xenotech's Research Director Angus Richards with a prototype of his company's 'no glasses' 3D TV display system.

No-glasses 3D

Xenotech's current 3D technology is a patented system for providing a single viewer with a large, bright, full colour and flicker-free television image which is truly 'solid' and three dimensional — but unlike most other systems does not require the use of special glasses or filters. (Although holographic 3D systems do not require the user to wear glasses, they provide transparent or 'ghost-like' images, and because of low image brightness are generally not suitable for use in normal ambient lighting conditions.) The Xenotech system is compatible with virtually any standard TV transmission and video recording format (including HDTV), and is also compatible with standard computer display formats.

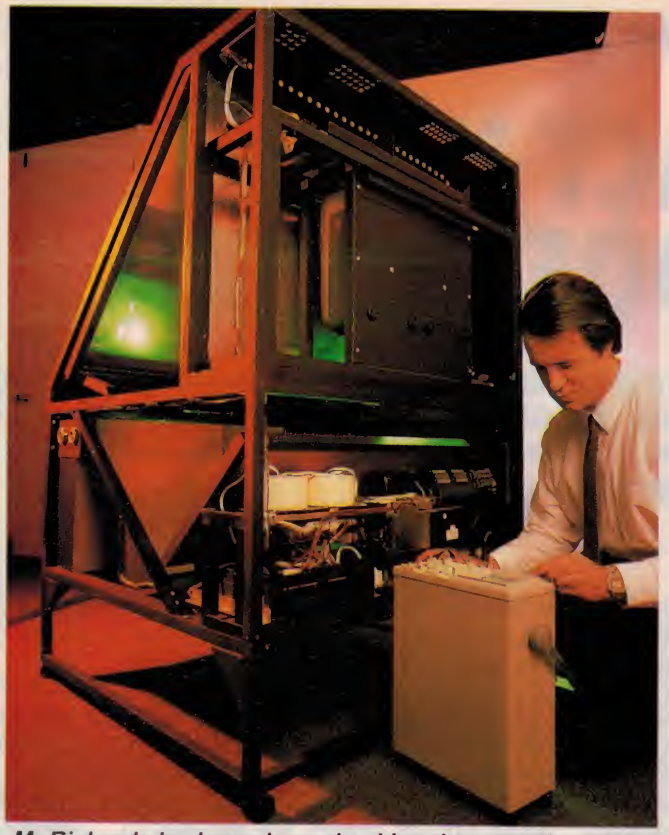
The combination of large image size and high brightness level is achieved by using a back projection system, while the full colour and flicker-free characteristics are achieved by using two video projectors — one to produce the image for each of the viewer's eyes — rather than the 'L-R-L-R...' single time multiplexed projector used in most previous systems. The use of two projectors operating continuously also avoids the need for special glasses, as well as increasing the average image brightness and allowing the system to operate in a normally lit room.

The really novel aspect of the Xenotech system, however, is its use of an eye-tracking system to ensure that the viewer's left eye always sees the L image, and the right eye the R image, regardless of the exact position of the viewer's

head and eyes. A miniature video camera underneath the 3D display images the viewer's head, and sophisticated image analysis hardware and software locates and tracks their eyes, automatically adjusting the positioning of the projected L and R images to keep them in the correct alignment for optimum 3D viewing. As a result the viewer's head has the freedom to move from side to side or vertically, without losing the 3D effect.

How it works

As shown in the diagrams the Xenotech system uses a compact folded optical system, in which the two video projectors are mounted vertically behind the silvered and highly reflective screen. The beams from each projector are reflected first by a pair of 45° mirrors at the bottom of the cabinet, and then by a partially silvered large mirror suspended at 45° in front of the screen — through which the viewer also sees the screen.



Mr Richards is shown here checking the operation of the prototype 3D display, which has some of the panels removed to reveal the 'works'.

The effect of this folded optical system is to ensure that the light from the projectors is incident on the screen at exactly the same angles as it would be if the projectors were positioned in front of the screen, in the plane of the viewer's eyes. And as the screen is highly reflective, the light is therefore reflected from it at the same angles. As roughly half of the reflected light passes through the partially silvered 45° mirror, this light is therefore potentially able to reach the viewer's eyes at the correct angle for optimum viewing.

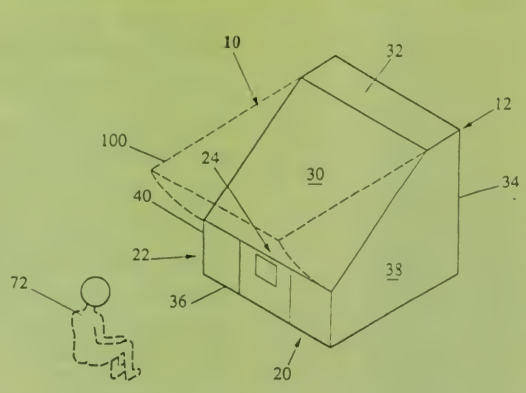
To ensure that this occurs regardless of the exact position of the viewer's head and eyes, the eye tracking system adjusts both the position of the video projectors and the precise tilt angle of the large partially silvered mirror. The projectors are moved in the horizontal plane to adjust for lateral movement of the viewer's head and eyes, while the partially silvered mirror (which is hinged along its top edge) is tilted to adjust for vertical movement.

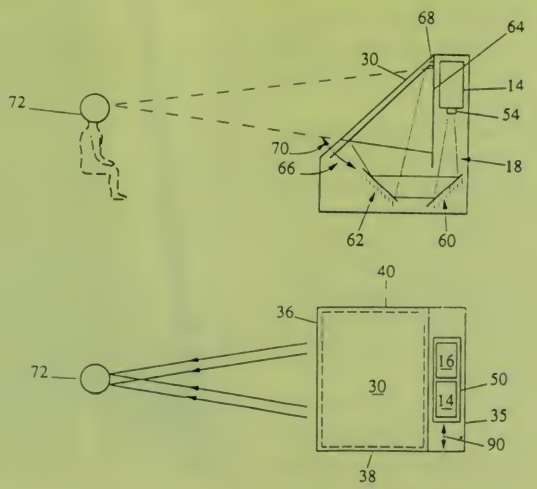
The nett result is a bright, clear and stable 3D image measuring approximately 1.5m diagonally, as seen by the unit's single viewer. If multiple viewers are present in front of the display, the current eye-tracking system simply 'locks on' to the viewer closest to the optimum position, and provides that viewer with the correct 3D image.

Although the initial system is clearly only capable of providing this optimised 3D display for a single viewer, it seems to be the first really practical system to achieve this without requiring special glasses, etc. And this gives it a large number of important potential applications, including video arcade games, 3D computer workstations, monitors for remote control of industrial equipment, simulator displays and remote sensing. That's why there's been so much interest in the technology, from companies around the world.

However Xenotech is already working on the development of multiple-viewer 3D display systems, using related technology. So we can probably expect to see further interesting developments from this innovative Western Australian company, before long.

Companies seeking further information can contact Xenotech Australia at Suite 1, 41 Walters Drive, Osborne Park 6017; phone (09) 446 3366, or fax (09) 446 3340. ❖





These diagrams show the basic construction of the single viewer 3D display. An eye tracking system optimises the 3D image.

EA Reviews the new

COMPACT VIFA SUBWOOFER KIT

If you're in the market for a small high performance subwoofer that can handle loads of power, this new speaker kit from Jaycar should fill the bill. Using one of Vifa's latest 200mm bass drivers in a compact vented enclosure, it achieves a low frequency response down to around 35Hz and boasts an impressive power rating of 150W RMS.

by ROB EVANS

Readers with an interest in loudspeaker construction are likely to have noticed the name Vifa popping up at regular intervals over the years, in both *EA* and *ETI* speaker kit construction articles. The respected Danish speaker manufacturer produces a wide range of drivers for both the home constructor and commercial loudspeaker manufacturing markets, and these have been an ideal choice for local speaker kits — thanks to their availability and above all, consistent performance.

In other words, by choosing a speaker kit designed around Vifa components, constructors can be confident that the specified drivers are readily available and the system's final performance will be very close to that of the prototype.

As it happens, though, the last Vifa based speaker system that appeared in *EA* was way back in the September 1988 issue, where we took a look at a neat 75 litre three-way setup based on Vifa's P25WO 245mm bass driver.

Things had been rather quiet on the Vifa front since that time, until Jaycar Electronics recently approached us with news that their stores would soon stock a whole new range of Vifa systems, designed expressly for Jaycar by South Australian firm *Australian Audio Consultants*.

And with its new effective status as a loudspeaker manufacturer, the further news is that Jaycar is now in a position to *directly* import Vifa drivers from Denmark, which should help to keep the pricing of their whole new range at an affordable and competitive level.

With the strong interest in compact subwoofers at the moment, thanks to the trend towards (visually) small speaker systems and multi-channel home theatre setups, we decided to check out one of the smaller units in the new Jaycar/Vifa line up: their compact 8" (200mm) subwoofer.

The JV80 subwoofer

Based around Vifa's new M22WR-09-06 200mm bass driver, the subwoofer uses a conventional bass reflex (or 'ported') enclosure with an internal volume of around 35 litres, which is constructed from 16mm 'MDF' board and has external dimensions of 600 x 270 x 300mm (H x W x D). The enclosure panels are finished in 'blackwood' veneer, and the kit is supplied with a front panel grille covered in plain black speaker cloth. All in all it has a fairly plain but functional appearance, which is pretty much what you need for a subwoofer that will probably spend its days hiding in a corner or under a piece of furniture.

In contrast to the simple enclosure design, the 200mm Vifa driver used to power the system is a rather sophisticated device and as you would expect, plays a major role in determining subwoofer's final performance. Featuring a braced magnesium basket assembly, very stiff paper cone and a low damping rubber surround, the M22WR-09-06 driver has been designed for high power applications in bass reflex enclosures, such as the one used here.

As part of the driver's high power capabilities, it also features a 50mm diameter long-throw voice coil assembly and a husky 1kg magnet assembly

with a vented pole piece. And according to the Vifa literature, all of this results in a nominal power rating of 150W RMS, a long term 'music' power rating of 300W, and a short term pulse power of 500W — impressive stuff from a 200mm driver...

The Jaycar JV80 subwoofer kit sells for an all up price of $349.45, and includes the M22WR driver, a pre-built enclosure and a suitably rated polyswitch speaker protection device. The components are also available individually, and are priced at $199.50 for the driver, $139.00 for the pre-built cabinet and $10.95 for the polyswitch. And as you would expect from a complete kit, the cabinet includes a grille cloth assembly, port tube, acoustic padding and the rear terminal plate — so that all that's required for the assembly stage is a screwdriver, soldering iron and less than an hour of free time.

Performance

The JV80 performed extremely well in both our subjective and objective tests, and really did demonstrate how a refined driver such as the Vifa M22WR can deliver the goods in a correctly tuned enclosure. While it will certainly cost you more than a similar unit powered by an 'equivalent' low cost driver of (say) Taiwanese origins, in the final analysis it probably just confirms the adage of 'you get what you pay for'...

The listening tests were conducted using a couple of different subwoofer amplifiers (one being our new 300W unit as described in the April and May issues), and with a variety of main or satellite speakers. In all cases we found the JV80 exhibited a smooth and well extended low-end response with little evidence of frequency doubling or cone breakup artifacts, even at high power levels.

This latter effect can be quite a problem with simple bass reflex subwoofer enclosures (as opposed to more complex 'bandpass' designs), since the front-mounted speaker is coupled *directly* to the surrounding air of the listening room. This in turn means that any high order harmonics (that is, distortion) generated by cone flexure are quite apparent to the ear, causing a muddy and ill defined upper bass reproduction. Presumably, the JV80's impressive performance in this regard can be attributed to the Vifa driver's very rigid cone assembly and low inherent distortion.

Other than that, our listening tests also indicated that the JV80 has a very good transient response — as we've come to expect from subwoofers based on a driver with a relatively small cone diameter — and it is slightly less efficient than comparable designs. This latter point became apparent when we compared the sound of the Vifa subwoofer to a similar bass reflex unit, then a small double-tuned bandpass design, where the JV80 had a noticeably lower output level in both tests.

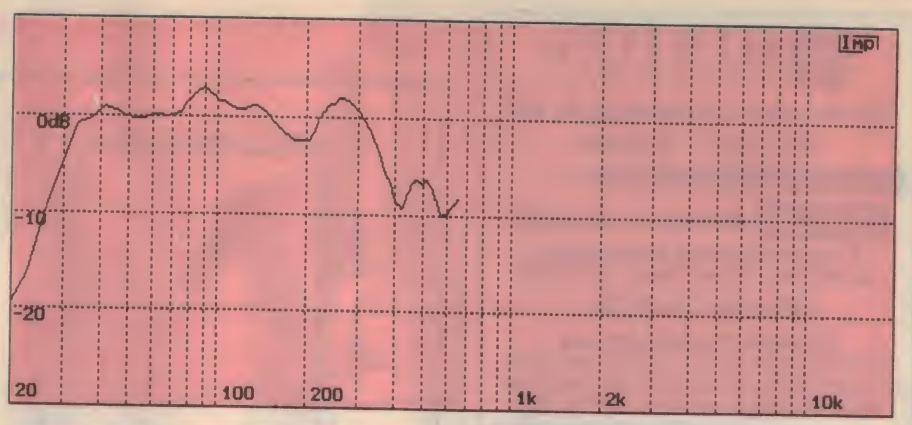


Fig.1: The JV80's low frequency response in a typical listening room, as measured with the IMP loudspeaker testing system — as you can see, it's commendably smooth at the low end.

While this effect is most likely due to the M22WR's fairly pedestrian efficiency figure of 88dB (at 1W/1m), the situation is offset to a large degree by the driver's very healthy power handling capability. So in practice, you just need to push it a little harder, to achieve the same acoustic level...

On the objective side of testing, the JV80 gave a good account of itself as we expected from the initial listening checks. As you can see from the response plot generated by our IMP loudspeaker testing system (Fig.1), the frequency response is commendably flat over the critical low-bass region between 30Hz and 200Hz. So when driven via a suitable crossover system (a passive or active low-pass filter) set to a typical upper roll-off point of say 100Hz, you could expect a smooth flat response down to the subwoofer's lower -3dB point of about 32Hz.

However, we should point out that the plot shown in Fig.1 was generated in a typical listening room with the JV80 placed about 300mm from the nearest wall, and standing on its narrowest end with the port opening near the floor.

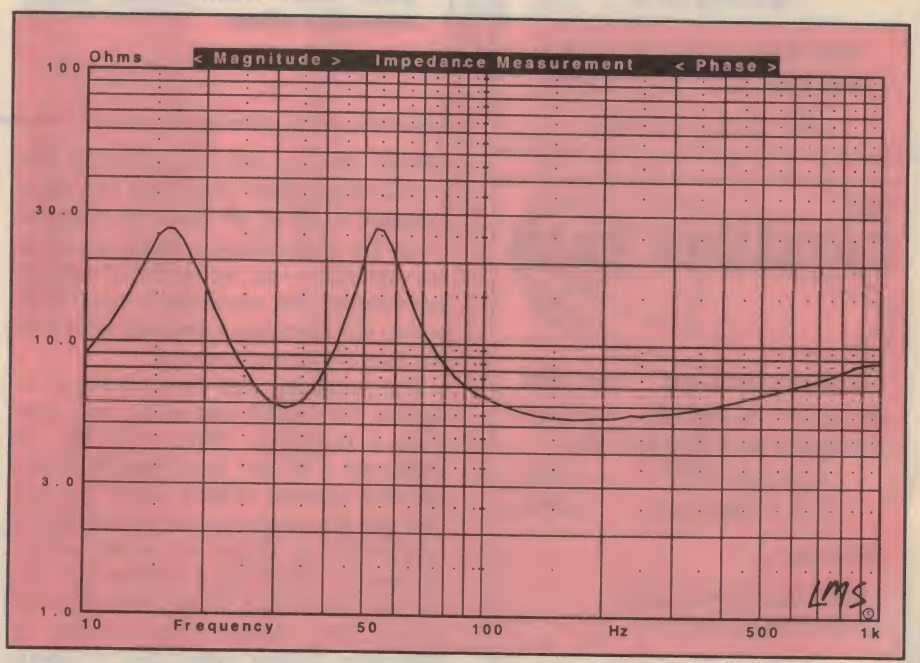


Fig.2: The impedance plot of the subwoofer over the 10Hz to 1kHz range. Its shape is typical of a vented enclosure design, and shows a minimum impedance of about six ohms in the low bass area.

COMPACT VIFA SUBWOOFER KIT

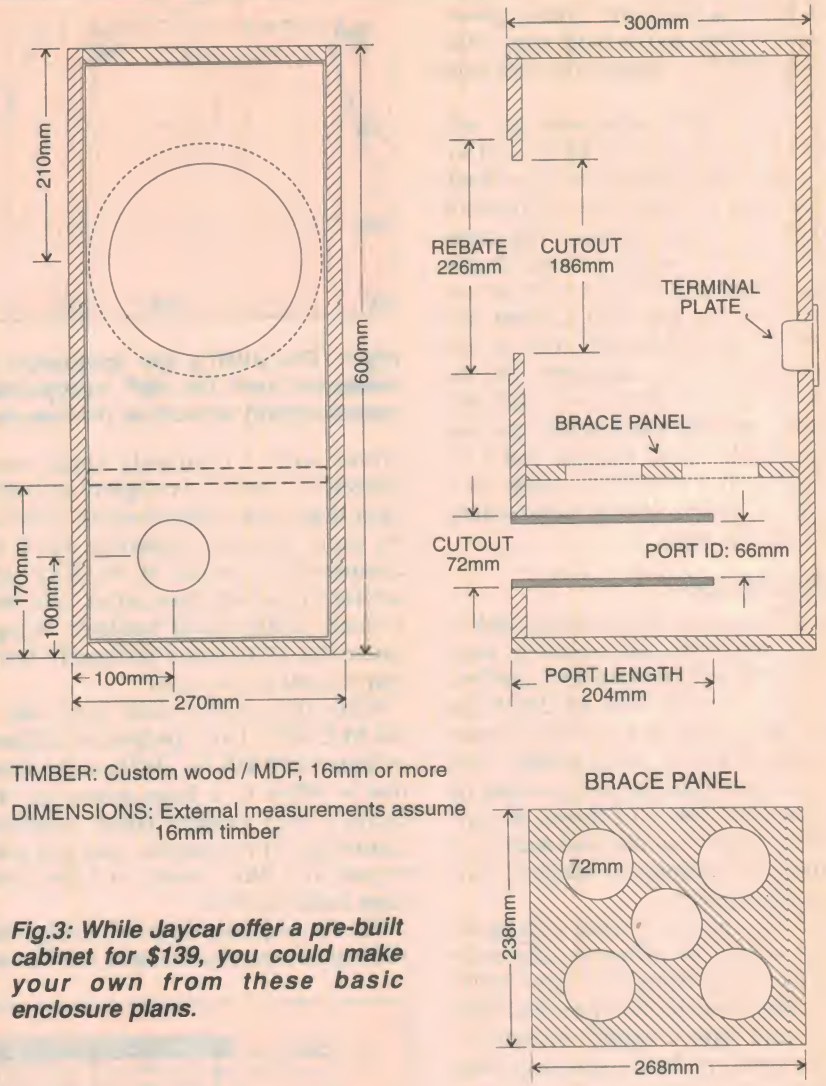


Fig.3: While Jaycar offer a pre-built cabinet for $139, you could make your own from these basic enclosure plans.

While this is not necessarily the positioning that provides the best response curve in all cases, we found it to be the most effective arrangement in our situation — as we've found with all subwoofers, the enclosure's orientation within the room has a dramatic effect on the final frequency response.

The remaining plot shown in Fig.2 indicates the JV80's impedance response over a range of 10Hz to 1kHz, as measured with our Loudspeaker Measurement System (LMS) setup. As you can see, the curve has the characteristic double hump shape of a bass reflex enclosure, indicating a port tuning frequency of around 32Hz (the dip between the humps), and shows a minimum system impedance of about 6Ω at low frequencies.

This impedance figure shouldn't present any problems, as most contemporary subwoofer amps will take this type of load in their stride.

Overall then, we were really quite impressed with our first contact with Jaycar's new Vifa line up, and are confident that the other models in the range should show a similar level of performance. The JV80 subwoofer will suit all but the largest subwoofer based sound systems, and when you consider its convincing performance, appears to represent very good value for money.

Needless to say, you can purchase a full kit of parts for the JV80 from your nearest Jaycar store, or if you have sufficient woodworking skills and equipment, just buy the essential components and build your own enclosure. At Jaycar's request, we've included a cabinet construction guide in this article, to help those taking the latter path — see Fig.3. ❖

DSE 'Discovery series' book and video:

INTRODUCTION TO BASIC ELECTRICITY

The latest addition to the Dick Smith Electronics 'Discovery Series' consists of an easy to read book and a 13-minute video, covering most aspects of electricity, energy and power. Available separately, the book and video aim to teach the beginner about the very basics of electricity.

by GRAHAM CATTLEY

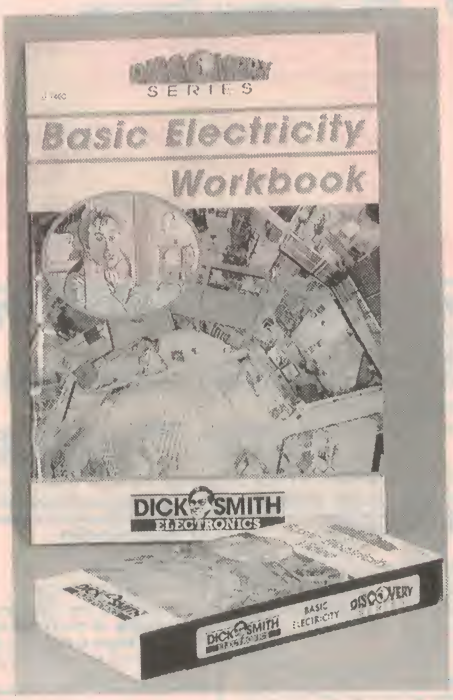
There are very few books around that deal with the really fundamental aspects of electronics. Most books assume some prior knowledge of the subject, skipping over such basic subjects as charge, energy and power. DSE's latest addition to its 'Discovery series' does a good job in rectifying the situation, with an introductory video and workbook combination. The package consists of a 37-page workbook and a 13-minute videotape, both of which were kindly lent to us for review by DSE.

The large format workbook seems quite comprehensive, containing six chapters, which cover: The nature of electric charge; Conductors, insulators, electric current and voltage; Energy and power; Voltage; and The relationship between voltage, current and power. At the end of each chapter are a series of review questions — over 50 in all, although only 16 are answered in the back of the book.

It seems though, that DSE have been a little ambitious in trying to cover such a large number of abstract concepts in only 37 pages; the ampere is explained in only two paragraphs, and the difference between conventional current and electron flow is covered in only three. I believe a novice would find the subjects hard to follow, if not confusing.

It should be stressed, however that this is a workbook, and as such, the reader is not expected to read the book once and come away with a full understanding of the subject. But while the various terms are clearly and succinctly defined, no examples are given for the reader to work through in order to reinforce the concepts that they have learned.

The review questions at the end of each chapter would have been a good way for readers to test their understanding, had answers been provided for all of the questions. As it stands, however, about 70% of the questions remain unanswered, leaving the reader largely unable to verify their interpretation of the text.



Mind you, the author states in the book's introduction that the book was written for 'Ordinary people who have no need or desire for an in-depth knowledge of classical physics'. This would seem to imply that the book is intended more to give the reader an idea of 'what it's all about' than a full working knowledge of electricity. The book fills *this* role quite well. It has a nice open layout, with good use made of boxes, headings and pictures, and the list of keywords at the start of each chapter makes it easy to find information on a particular subject.

The companion educational video is sold separately, and gives a somewhat 'entertaining' introduction to the basic principles behind electricity. It starts off with an introduction by a man in 19th-century costume talking about electrical charge. It then moves on to briefly explain the the size of atoms, the difference between conductors and insulators, energy, AC and DC, and the formulas for power calculations.

It's a shame that DSE didn't make more use of the possibilities available to them through the use of a video presentation. While all the above points were covered, the only demonstration of any electrical effect was a charged plastic rod attracting the corner of a piece of paper. The use of some animation, or even a few diagrams, would have helped matters along no end. Instead, we get a few incongruous shots of the Lucas Heights nuclear reactor, and the odd still of a lightbulb or powerline.

Again, trying to squeeze so many concepts into such a small space has not helped. The video hops between wildly disparate subjects with such speed that the viewer may well be left bewildered. With only seconds given to some subjects, there is potential for confusion.

One of the greatest problems I had in reviewing this video was in determining the age group of the intended audience. From the presentation style, it would seem to be aimed at younger viewers, however I felt that anyone able to understand all of the points raised would be somewhat patronised by the whole approach. On the other hand, even if all the subjects were not fully understood, this video could promote an interest in an otherwise impenetrable subject.

To sum it up, then, the book is certainly worth the $7.95 price tag, and while the video has room for improvement, at $14.95 it provides incentive to follow through the book, and gives the package more appeal, particularly to a younger audience. ❖

ROD IRVING ELECTRONICS PTY. LTD.
YOUR FIRST CHOICE IN QUALITY ELECTRONICS A.C.N. 005 428 437 ESTABLISHED SINCE 1977
ROD'S HOTLINE 1-800 33 5757
MAIL ORDER LOCAL CALLS: (03) 543 7877

SHAREWARE

NEW LOW PRICES! Thousands of titles available. Shareware cost **only** $2.95 for 5.25" disk. Disks are in 3.5" 720K or 5.25" 360K format unless specified as others in catalogue descriptions. Catalogue - $3.95

PRICING FOR OTHER DISKS FORMAT:	5.25" DD -	$2.95
	3.5" DD -	$4.95
	3.5" HD -	$6.95

Some of the most popular titles avaliable:

- **Rise of the Triad*** - Disk No. 1047 to 1049 (3 x 3½ 1.44MB)
- **Wacky Wheels*** - Disk No. 340, 341 (2 x 3½ 1.44MB)
- **One Must Fall**- Disk No. 146, 147 (2 x 3½ 1.44MB)
- **Highway Hunter*** - Disk No. 717 (1 x 3½ 1.44MB)
- **Descent*** - Disk No. 183, 184 (2 x 3½ 1.44MB)
- **Heretics*** - Disk No. 845, 846 (2 x 3½ 1.44MB)
- **Doom*** - Disk No. 1579, 1580 (2 x 3½ 1.44MB)
- **Raptor: Call of the Shadows** - Disk No. 1583, 1584 (2 x 3½ 1.44MB)

**All this games can be played interactively with our serial laplink cable- F/F9 and 25 pin combination cable, Cat No. P19070.*

IBM ExecJet II 4076 Printer

by Lexmark

Ink-jet printer for high quality text & graphics. Output on envelopes, paper, labels & transparencies • 300 x 300 dpi, 3ppm • Print Quality Enhancement Technology for smooth images • Emulation mode - PCL3 & IBM PPDS • Serial interface (RS-232, RS-422)

Comes with Power Cord, User's Guide, Driver Software, etc.

Lexmark Colour Inkjet Printer

600 dpi (with PQET) in black & 300 dpi in colour. Includes 150 sheet feeder. 300cps in black print mode and 240 cps in full colour.

75/90/100MHz Pentium™ Motherboard with onboard I/O & IDE interfaces

At last! True high performance power unleashed with this motherboard that has ISA I/O and IDE interfaces all incorporated onboard. The mainboard is a Pentium™ micro processor based PC/AT system, supports 256kb to 1MB cache with ISA bus and PCI Local Bus to upgrade your system performance. It is ideal for multi-tasking and fully supports MS/DOS, Windows, Windows NT, Novell. OS/2, etc.

FEATURES:

-Green Function:
• Supports power management operation via BIOS. • Powersdown timer from 0.25 to 512 mins. • Wakes up by any key pressed. • Green mode selection via software or hardware.

-CPU:
• The Pentium micro processor P54C provides the new generation power for high-end workstations and servers.
• CPU socket is 320-pin ZIF socket (socket 5).

-Speed:
• Supports 75/90/100MHz CPU speed • Supports 25/30/33MHz PCI LOCAL BUS speed • Speed selection via software. • I/O clock 8MHz for ISA Bus.

-Shadow RAM:
• A memory controller provides shadow RAM and supports 8-bit ROM BIOS.

-DRAM Memory:
• Supports 4 banks (4pcs) 72-pin 1/2/4/8/16/32MB SIMM module socket. • Supports DRAM memory up to 128MB onboard. • DRAM type: page mode, 70ns required.

-Cache Memory:
• Cache SRAM from 256K to 1MB, write back.

-BUS Slots:
• Four 16-bit ISA Bus slots and three PCI Local Bus slots

-BUS -PCI Enhanced IDE on board:
• Supports 4 IDE hard disk drives • Supports mode 3, high performance hard disk drives • Support IDE interface CD-ROM • Support high capacity hard disk drives

-BIOS:
• AWARD legal BIOS

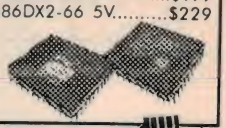
Cables included for: HDD • FDD • SERIAL PORT • PRINTER PORT • GAME PORT

-ISA I/O On Board:
• Supports - two serial, one parallel and one game port • Supports 360KB, 720KB, 1.2MB and 1.44MB floppy disk drives.

LATEST CPU PRICE

intel CPU		AMD CPU	
486DX2-66	$429	486DX2-66	$279
486DX2-66 OverDrive Chip	$299	486DX2-80 *NEW!*	$349
486DX4-100 OverDrive Chip	$599	486DX4-100 *NEW!*	$499
PENTIUM 60MHz	$499	**CYRIX CPU**	
PENTIUM 66MHz	$545	486DX2-50	$199
PENTIUM 75MHz	$699	486DX2-66 3.3V	$199
PENTIUM 90MHz	$999	486DX2-66 5V	$229
PENTIUM 100MHz	$1795		

AVAILABLE ON ORDER THROUGH OUR STORES OR BY MAIL ORDER



COMPUTER CARDS - HUGE RANGE!!

I.S.A.

CAT NO.	DESCRIPTIONS	PRICE
X18075	1meg Trident/Cirrus VESA	$109
X18077	512K TRIDENT VGA	$89
X18004	IDE/SPG	$39
X18013	IDE	$19
X17072	ADAPTEC SCSI 16bit 1522A	$199
X18161	*16bit ETHERNET NE2000	$79
X18169	16bit NE2000+	$269
X18151	S.P.G.	$25
X18190	Printer 2-Port Slct Lpt 1-2 Card	$39
X18191	Printer Port Slct Lpt 1-2-3 Card	$49
X18141	High Speed Serial Card 1-Port 16550	$59.95
X18041	High Speed Serial Card 2-Port 16550AFN	$79
X18143	High Speed Serial Card 4-Port 16550AFN	$189
	S.P.G with 1655 UART CHIP	$44.95
X18019	Games Card	$19
C14260	SMART GAMES Cont	$39.95
X18177	CD ROM Controller	$45
X19936	ISA Scanner Card GS4500	$79
	2.88 FDD Controller Card	$125

Specifications subject to changes. *X18161 without Boot Roms.

VESA LOCAL BUS

CAT.	DESCRIPTION	PRICE
X18002	VESA MULTI I/O	$39
X18099	VESA 1 Meg TRIDENT 9400	$129
X18100	VESA CIRRUS 5428	$139
X18184	VESA PARADISE 1Meg	$299
X18186	VESA IDE Cache Cont	$349
X17071	VESA SCSI 2, IDE, Floppy, Multi I/O	$299
X18087	VESA WD Accelerator Video Card	$209
X18167	VESA VGA S3 Accelerator	$149
X18185	VESA ET-4000 TSENG LABS	$245
X18149	VESA CLOUD9 VGA 2 MEG	$449
X18047	VESA IDE ENHANCED MULTI I/O	$139
X18182	VESA CACHED IDE MULTI I/O	$280

P.C.I.

CAT.	DESCRIPTION	PRICE
X17078	PCI SCSI IDE FLOPPY MULTI I/O	$229
X17900	PCI 1M VGA	$179
X18179	PCI IDE CONTROLLER	$49
X18181	PCI DIAMOND VIPER 2MEG	$799

SUBSCRIBE TO Communicate! IT'S FULL OF TECHNICAL ADVISE, SPECIALS, NEW PRODUCTS AND INFO UPDATES ON PAST & PRESENT TECHNOLOGIES...

What you will have missed, if you are not a subscriber - in April, you would have bought a HP520 printer for just $399.00! Plus loads of other special offers! So stopping kicking yourself and put in your subscription today!

Communicate!, a 32 pages newsletter is a team effort production involving Rod Irving Electronics' own advertising & technical department.

I would like to subscribe to 12 issues of *COMMUNICATE!* starting on.....(month) at $12.00 for 12 editions.

Name..... Address.....

P/Code.....Phone.....Fax.....

B/CARD
VISA
M/CARD
AMEX
DINERS

Signature: .....Exp. Date:.....

EAJUN'95

We have stores in Melbourne and also in Adelaide & Sydney, to better serve you...

☐ **MELBOURNE:** 48 A'BECKETT ST, MELBOURNE 3000
• PH: (03) 663 6151 • FAX: (03) 639 1641
• Mon-Thurs: 9.00-5.30pm • Fri: 9.00-8.00pm • Sat: 9.00-1.00pm

☐ **VERMONT:** 190 ROOKS RD, VERMONT 3133
• PH: (03) 874 8888 • FAX: (03) 874 2288
• Mon-Fri: 9.00-5.30pm • Sat: 9.00-1.00pm

☐ **OAKLEIGH:** 240C HUNTINGDALE RD, OAKLEIGH 3166
• PH: (03) 562 8939 • FAX: (03) 562 8940
• Mon-Fri: 9.00-5.30pm • Sat: 9.00-1.00pm

☐ **NORTHCOTE:** 423 HIGH ST, NORTHCOTE 3070
• PH: (03) 489 8866 • FAX: (03) 489 8131
• Mon-Fri: 9.00-5.30pm • Sat: 9.00-1.00pm

☐ **BOX HILL:** 1031 MAROONDAH HWY, BOX HILL 3128
• PH: (03) 899 6033 • FAX: (03) 899 0156
• Mon-Fri: 9.00-5.30pm • Sat: 9.00-3.00pm

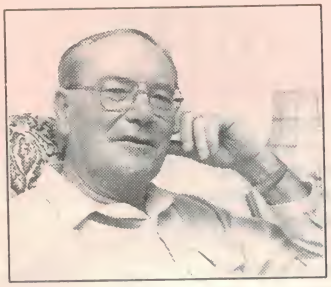
☐ **CLAYTON:** 56 RENVER RD, CLAYTON 3168
• PH: (03) 543 7877 • FAX: (03) 543 8295
• Mon-Fri: 9.00-5.30pm • Sat: 9.00-12.00pm

☐ **BLUESTAR COMPUTERS:** 271 MAROONDAH HWY, RINGWOOD 3134
• PH: (03) 870 1800 • FAX: (03) 879 3027
• Mon-Fri: 9.00-5.30pm • Sat: 9.00-1.00pm

☐ **SYDNEY:** 74 PARRAMATTA RD, STANMORE 2048
• PH: (02) 519 3888 • FAX: (02) 516 5024
• Mon-TFri: 9.00-5.30pm • Sat: 9.00-1.00pm

☐ **ADELAIDE:** 241-243 WRIGHT ST, ADELAIDE 5000
• PH: (08) 211 7200 • FAX: (08) 211 7273 • Mon-Thurs: 9.00-5.30pm
• Fri: 9.00-8.30pm • Sat: 9.00-5.00pm • Sun: 10.00-4.00pm

CPUCARDA-APR '95



When I Think Back...

by Neville Williams

Who can ever forget the post-war disposals stores — like A.C.E. Radio?

A memorable aspect of the post-war era, for Australian electronics hobbyists, was the appearance of military surplus disposal stores offering an intriguing range of bits-and-pieces, and redundant built-up units at prices which were often a fraction of what they might otherwise have been. Useful at the time, many of those same bits have since become interesting 'collectables' for public and private museums. Pardon me if I ramble a bit, but it's that kind of a subject!

First a personal observation: At one stage in the 1960s, at the height of the disposals era, I had seemingly acquired enough bits and pieces from disposals stores and elsewhere to start a modest museum of my own — posing a threat to our domestic living environment and the space available for the family car!

I recall that one stout, bulky carton contained an Australian made 'LW' (light-weight) radar transmitter, complete with magnetron but utterly useless for anything other than its original purpose. A few years earlier, its very existance had been a closely guarded secret, but I had later staggered away with one for virtually nothing — brand spanking new, by courtesy of Jack Lewis of the Classic Radio group.

At the other extreme, in terms of utility, I picked up a Paton SG-1 signal generator from A.C.E. Radio — again cheaply, because it wasn't working. But, given a few evenings of TLC (tender loving care), it came good and has worked ever since on my bench — valves and electrolytic capacitors notwithstanding!

An in-between acquisition was an American made field multimeter, in a steel case, using a large 50uA movement — this was before the era of protection circuitry. I hesitated to use it for everyday bench work, because of its bulk and vulnerability to inadvertent measurement overload, and my faithful old Calstan 1000 ohms/volt meter still copped most of the work.

For the rest, most of my petty cash went on valves — dozens of them — from EF50 and 6AC7 RF pentodes to 807 beam tubes, 866 rectifiers, and imposing transmitter 'bottles' like the 803.

On the job — a smiling Joe Ellison, posed against an assortment of valves in one of the tidier corners of the A.C.E. Radio display.

These, and useful little two-inch square meters, which turned up regularly on the bargain counter at Prices Radio in prestige brands like Ferranti, Weston and Jewell.

Drawing on my boxes of 'goodies', I built up a multi-band VHF transmitter using 'disposals' crystals re-ground by *R&H*'s then Editor, John Moyle. A few months later, I came across an ex-disposals calibrated, tuneable aircraft transmitter which proved very successful as an add-on VFO. Was it from Walthan Trading, Metropolitan Radio, Paragon Radio, Deitch Bros, Lance Chapman, Mike Sheridan or someone else? I can't remember...

Another British aircraft transmitter, ratchet tuneable across the UHF band, set me up on the 144MHz amateur band — provided I didn't attempt to change the preset frequency too often. Operating within the noise field of a Rolls-Royce Merlin engine, one mightn't have noticed; but in the comparative quiet of a suburban backyard ham shack, the ratchet preset tuning system generated a passable noise simulation of a machine gun — all by itself!

Both transmitters, along with a five-metre job from mainly disposals bits, have long since been pensioned off and there is once again room to move in the house! Such, for me, was the lure of disposals equipment.

Home-ground crystals

Former Editor John Moyle's pride and joy was a heterodyne type frequency meter which, as I remember, he picked up from a Melbourne disposals dealer. Using type 30 battery triodes and dependent on its individually calibrated handbook, it was a tedious instrument by modern standards; but he used it to regrind numerous crystals for his own transmitters, while also helping out other members of the magazine staff.

Not surprisingly, some of John's own petty cash went on stray crystals which, in those days, were mostly mounted in hand-assembled plug-in holders — some from overseas, others from AWA and Melbourne's Max Bowden.

Similarly for other members of the *R&H* staff, with the further observation: every one seemed to have hoarded hanks of assorted coaxial cable bearing obscure type numbers, for possible use with 'ham' rigs or TV sets. All too often the hanks proved to be of inadequate length, unsuitable impedance or too 'lossy'.

Any number of other old timers, I guess, will recall having invested in ex-disposals parts with the best of intentions, often to realise that, months later, many of the bits were still sitting in their original packing, untouched. Like me, they were on their way to having their own mini-disposals store on site!

One could doubtless ramble on in this fashion, but I will simply add an observation by Selwyn Sayers, *EA*'s long serving Advertising Manager. Having joined the staff around 1960, at the height of the disposals boom, he branded this present article as "timely because, in advertising terms, it marks the end of that whole era".

In point of fact, the notion of covering wartime electronic 'disposals' stores in these columns arose in part from a letter mentioned in the March issue, from Terry Parritt of Upper Hutt, NZ. Terry said he had picked up a basic familiarity with radio in the 1930s from discarded 20's-style radio sets and government surplus bits, plentiful in second-hand stores in the UK at the time. He wondered whether we'd had similar stores in Australia.

About the same time, Editor Jim Rowe mentioned in conversation an ex-patriot English radio engineer who had inquired whether we planned to cover Australian surplus stores like A.C.E. Radio, which he used to visit regularly in the old days. If we were interested, he had taken a number of colour slides at the time, which would be available for publication.

The A.C.E Radio premises in Marrickville, just before the building was sold. When formed in 1934, the company was registered as Excelair Radio and supplied built-up radio chassies.

When I finally got to talk to the aforesaid radio engineer, John Rich, he proved be a much younger man than Terry Parritt — born in 1940. But he was nevertheless able to confirm that well stocked second-hand ('junk') radio shops had indeed been plentiful in the UK in the 1930s. Such had not been the case in Australia until after WW2 — an era, as I said, that is now passing into history.

Australian stores

It gave me cause to recall the early 1930s when, as an impecunious wirer, I used to haunt the wireless shops in the Sydney CBD during my lunch hour — partly to fill in time and partly in the hope of spotting an affordable bargain.

There were three or four shops in the Royal Arcade which, very occasionally, offered a tempting addition to their standard display. Near the George Street end was the store which originally belonged to Mrs F.V. Wallace. Further down was Joe Keeps' shop, carrying telephone oddments from the PMG Dept.

Across the road, in nearby Pitt Street, was (Joe) Levenson's Radio, noted more for buzzers, Morse keys, mini-telescopes and other such technical toys than for radio parts.

Further up Pitt Street was Radio House, with an excellent display of radio and electrical parts, keenly priced but with few clearance bargains. And then there was Murdochs, a men's emporium diagonally across from the Town Hall, with a handyman section stocked with tools and radio oddments but, again, few clearance bargains.

If Australian hobbyists were to collect unwanted surplus wireless components in those days, they had to obtain them privately rather than over the counter.

At the end of WW2, however, Australia was suddenly awash with surplus military equipment. It was then that entrepreneurs with some knowledge of electronics and capital to spare realised that there was money to be made, by buying surplus electronic whatnots in bulk from government stores and marketing them to enthusiasts directly and/or by mail order through technical publications like *Radio & Hobbies*. No less to the point, apart from long term enthusiasts, there was a whole new generation of potential hobbyists who had been introduced to electronics during recent military service.

Their would-be suppliers ranged from novice investors to executives of established electronic firms who saw the chance to grab a share of the action. Harry Carter of A.C.E. Radio, specifically mentioned by John Rich was one of the latter.

We are indebted to the late Allan Falson for an account of how the system ultimately worked out in practice (*EA*, Dec.'92).

Getting their bargains

Government Stores would publish details of what was to be auctioned, at certain times and places. Professional dealers would confer beforehand and decide on the likely demand for the

various items on offer, an end price that would appeal to the public and how many units each dealer would be prepared to buy.

At the auction, bids were conventionally invited first for one-off items so that private buyers could be accommodated. Bids were then called for specified lots, and only one prearranged dealer would appear to be interested, with no more than purely token competition. A bid having been accepted, orders would be placed to cover the total needs of the group. Similarly for other items, with different dealers leading the bidding on each occasion.

At the end of the day, there would be a grand settlement with members of the group covering their respective cash committments and arranging to pick up their share of the purchases. Chatting with Lance Chapman during the preparation of this article, I mentioned what Allan Falson had told me. Said Lance: "The 'cartel' approach was the only effective way for us to buy!"

Collusion it undoubtedly was, but it was probably reflected in a more attractive price to the ultimate purchasers. One also has to take into account that a significant quantity of war surplus and lend-lease equipment never went under the hammer at all — being written off, dumped at sea or buried as landfill in disused brick pits. Anything to get rid of the stuff!

(I mentioned this to Geoff Wood, a former advertiser in this magazine, who told me how, as a member of the RAAF maintenance staff and under orders, he had personally supervised the postwar dumping of surplus aircraft engines and machine tools into the depths of Darwin Harbour...)

In conversation, John Rich said that his own interest in disposals stores — A.C.E. Radio in particular — was not primarily as a source of components for personal use, but rather because such stores were a repository for apparatus and components that belonged to electronics history.

Paid to enjoy himself!

Born in the South of England, he had trained and worked in the UK as an industrial electronics engineer until he felt that he had endured more then his share of overcast, biting winds, sleet and cold. He had accordingly headed for Australia, where he found that he could pursue his interests and career in a warm environment, under sunny skies and 'be paid money to do so'!

In fact, he has done just that for the past 25 years, tending to specialise in digital control of industrial processes 'from blast furnaces to icecream factories' — much of the work being at the 'cutting edge' of design. He worked with Philips in the early 1970s, during the development of their microprocessor controlled traffic signals — a world first.

Once the kitchen sink, by the time this picture was taken there was barely enough room remaining to make a cup of tea.

Chatting informally about such matters, as a couple of C-60 tapes slid unobtrusively through my cassette recorder, I sensed a man who combined a practical respect for modern microtechnology with a genuine affection for the patient and ingenious methodology of other days.

That is why his mind returns easily to the historic RAF (Royal Air Force) and RN (Royal Navy) installations which still dot Britain; why he now spends much of his spare time getting his hands dirty, to reclaim and maintain historic boats/ships for the Sydney Maritime Museum; and why he is also on the lookout for the bits and pieces to recreate historic wireless rooms on such ships.

Again, when the subject turned to the 'Sixty Milers' that once hauled coal from Newcastle to Sydney for the coal-gas suppliers, before the days of natural gas, he told me of the North Sydney terminal that he had visited; of the wheelbarrows and shovels that were still right where the workmen had left them; and, as it were, the ghostly presence of the men themselves!

As for voices, he is also active in oral history and is well acquainted with the efforts of the ABC's Stephen Pratley, producer of the historic wireless history tapes 'Bright Sparks'.

But, jumping several decades, he is also on the committee of the Computer Museum Society, and grateful that examples of the 'world first' Australian Philips digital traffic controller, which are just being decommissioned, may be offered by the RTA (Road Traffic Authority) to museums, thus preserving them for posterity.

Surprise! Surprise!

Getting back to A.C.E. Radio, he said that one of his most intriguing discoveries among the 'junk' was a couple of very light weight 19-inch equipment racks. He was told that they once held communications equipment carried on sleds and used by an Australian expedition to the Antarctic. Only the racks remained...

In conversation, I mentioned finding a particularly handsome transmitting valve that had probably belonged once to the Royal Navy. The glasswork was flawless and unclouded, the nickel electrodes as shiny as the day they were mounted and the nickel base similarly unmarked. It had adorned our mantel shelf at home with all the aplomb of a Venetian ornament, until it was crowded out by family photos.

Said John Rich: "There were boxes of magnificent old valves like that at A.C.E. Radio. I tried to talk Joe Ellison into supplying polished wood stands, which could be drilled to accept the base pins, but he wasn't interested. They would have made magnificent 'conversation pieces' on an executive table..."

"Joe would have been happier if they'd been like the stacks of high frequency power transformers he collected, unusable on 50Hz mains. He could have piled them in a heap and flogged them off to a scrap metal dealer."

There were also lots of cathode ray tubes, as I recall, some still in their original cartons, others piled bare into boxes as exposed and vulnerable as eggs in a paper bag. The most useful ones were American 5-inch diameter 5BP1's and British 6-inch VCR97's. I tried them both in a home made bench oscilloscope and a junk-based TV receiver, producing a green picture the size of a visiting card.

Quite a few readers followed suit (*Editor's Note: Including me!*), and found as I did that one would logically buy two or three extra tubes for future use — in case the originals became gassy. The spares weren't heavy, but they did add significantly to the stuff piled up in the home!

In fact, I also took home couple of 10-inch diameter tubes in the forlorn hope that they would provide a larger TV picture. Most of them, unfortunately produced a blue, long persistance image which was hardly appropriate for the action on a TV screen. Worse still, they tended to build up a static charge on the screen which smeared the image randomly, like an oil slick on a wet road!

Short on facts

So much for what I warned at the outset might be a rambling treatment of the subject. When it comes to the actual history of A.C.E. Radio, I find myself lamentably short of facts. Maybe — just maybe — there is someone out there who can help fill the gaps.

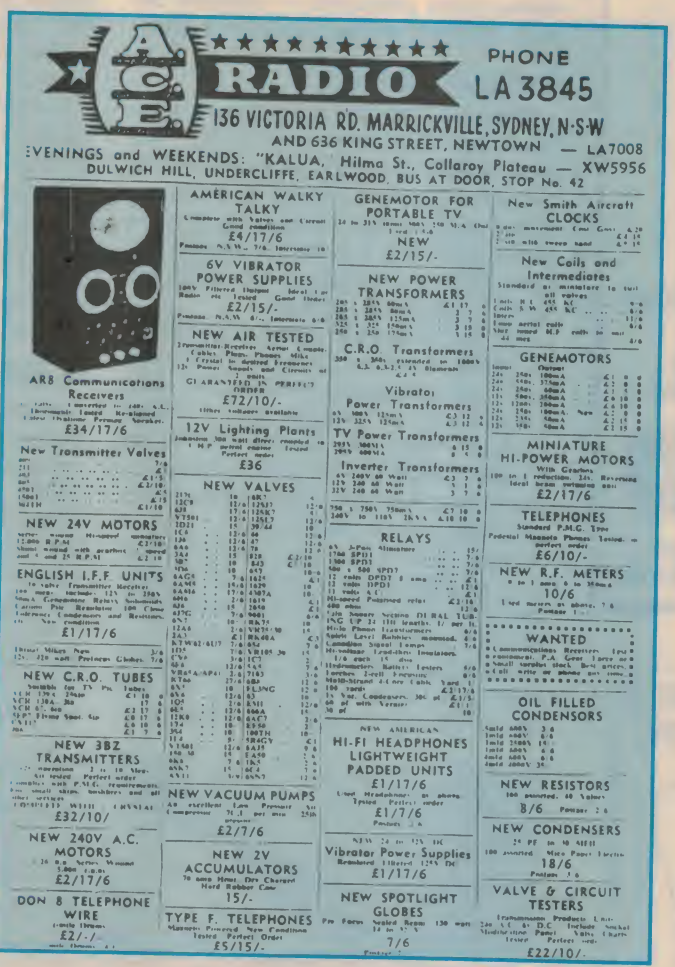
According to John Rich, Harry Carter set up a business at the Victoria Road, Marrickville address in 1934 — about the same time that I left High School and started work as a wirer at Reliance Radio. Joe Ellison had told him that Harry had claimed advertising support of *Radio & Hobbies* in just about every issue since Vol.1, No.1.

A check through as many issues as I had access to suggested that the one advertiser who can justly claim 'never missed an issue' would be RCS Radio.

John also alerted me to the fact that Harry's company had been registered under the name 'Excelair Radio', which I remembered vaguely but could not find in my 1939 copy of Mingay's *Radio Trade Annual*. Nor was there any mention of Harry Carter himself.

However, thumbing through my time-worn bound volume 13 of this magazine — from April 1951 — I came across regular full page advertisements for Excelair Radio, offering kits for radio homebuilders and/or a range of complete chasses, built up and tested. Harry Carter had set up the Marrickville cottage as a small radio factory, possibly supplemented by enthusiasts working on a cottage industry basis. Either way, he was obviously doing well enough to pay for full-page advertisements.

Some issues contained a second Excelair page offering war surplus clearance items, as also were Prices Radio, Metropolitan Radio Supplies, Deitch Bros, Motor Spares Ltd, Electronic Equipment Co, Surplus Stores, Waltham Trading, Goodman — an incomplete list, in the order I came upon them. Looking at the contents, it is evident that, having established their credibility with war surplus trading, some of them had also tapped into left-over stocks held by local manufacturers/distributors.



Although somewhat reduced in size, this reproduction of a page from an A.C.E advert in May 1959, gives a good idea of the range of disposals items on offer.

All in the family

At about this same time (1952) Harry Carter was joined by Joe Ellison, who sealed the arrangement by marrying one of Harry Carter's daughters, thereby becoming a son-in-law.

Curiously, Harry gained another son-in-law in the person of Jack Lewis, the owner and manager of Classic Radio, operating from premises in Parramatta Rd, Ashfield — obliquely across the way from the old AWA factory. Jack also supplied built-up equipment, but had separate outlets to handle disposals trading.

Returning to Harry Carter, it is evident from the advertisements that disposals activities gradually swamped Excelair Radio. Room after room in the Victoria Road building — an ordinary brick cottage — was filled with disposals equipment, as was the original front verandah and patio space at the rear. After that the purchases were stacked in the backyard, with or without protective tarpaulins.

I well remember, as do others, the dismay at seeing equipment in crates or cardboard cartons, dripping wet in the rain — equipment for which we might otherwise have found a nice, dry spot on our own workbench!

Inside the cottage, out of the rain, the 'office' had shrunk to a mere break in the endless procession of boxes and bits, with just enough space to accommodate a chair and kitchen sink, telephone, paperwork and a few relevant magazines. Nearby was the wherewithal to make a cup of tea. Elsewhere, according to John Rich, all evidence of a one-time radio workshop had been buried under boxes and bits.

In 1950, the name of the company had been changed to 'A.C.E.' which signified

Amplification, Communications and Electronics. Hence the full points after each letter in the registered logo.

When I compared notes with Selwyn Sayers, *EA*'s Advertising Manager, he recalled some of the agonies of the company's advertisements, of which I was also a witness from the editorial chair. In the 'old days', when Excelair was seeking to promote new radio chassies, the advertisements were well planned and attractive — probably the work of a professional advertising agent.

Difficult adverts

When the emphasis turned to non-descript disposals oddments, the presentation changed from commercial art into an urge to cram in as many items as possible. Compositors were presented with tiny illustrations and descriptive paragraphs to be set in the smallest practical typeface.

For the following month they would be likely to receive a copy of the previous advertisement, with hand-written instructions to 'change this', 'delete that', or 'insert this instead of'. As the months rolled by, the instructions became more involved, requiring more frequent reference to past issues.

These days, with computerised setting, they wouldn't have posed such a problem, but 20 years ago illustrations involved zinc 'blocks' attached to rectangles of type metal. Text comprised individual lines of type metal, set and cast by linotype machines. To make up a page involved stacking and packing the lines and blocks into a page sized metal tray, to satisfy the layout instructions.

As if that wasn't problem enough, the contents of the tray rested face up on the compositor's bench so that *he* had to manipulate in metal a mirror image of the layout instructions to produce a finished page that was the right way round. Needless to say, setting up an A.C.E. advertisement was not the most sought after assignment among the Fairfax 'comps'!

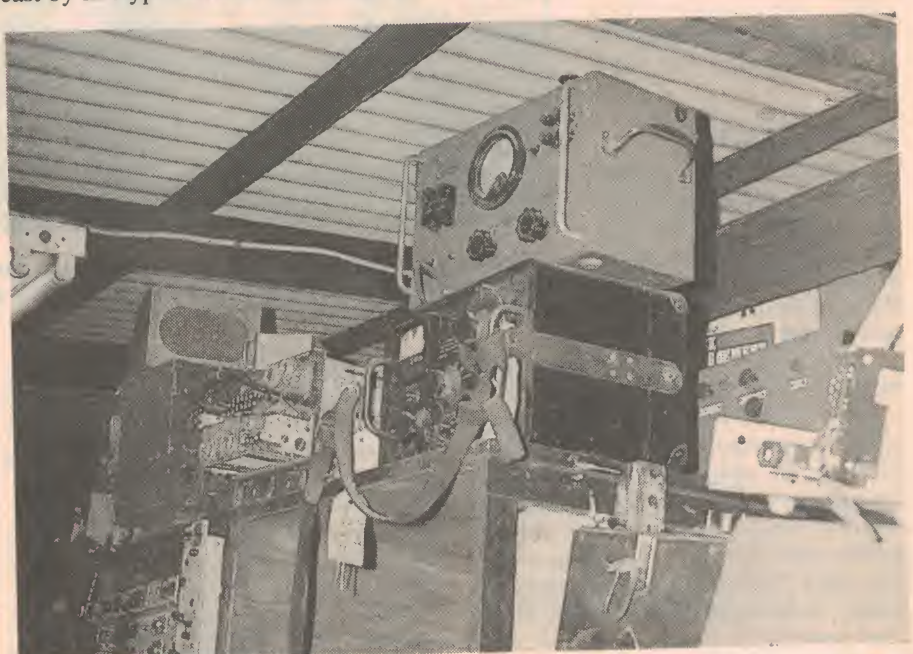
One other story related by Selwyn Sayers is worth re-telling.

Completely hemmed in by disposals whatnots, Harry Carter found it difficult to keep up with his mail, with the result that Selwyn Sayers received more than his share of complaints about A.C.E.'s slow response to orders. He, in turn used to ring Harry to warn him that he'd have to adopt a better system — or risk having his advertisements refused.

A different level

Harry was reputed to be affable and honest, even if a 'rough diamond', but he seemed not to comprehend why a bloke 'in the sticks' would need to write to the magazine, just because A.C.E. took a few extra days to fill his order! Did they think he, Harry, was some kind of a shyster?

When Sel finally threatened to 'pull the plug' on A.C.E. for the next issue, Harry felt sure that the publishers had a hidden agenda — their real concern



Stacked to the sloping roof on a verandah, this display may well have contained some interesting items for those who could recognise them.

was probably his ability to pay the bill. His response to Sel: "I want to talk to your boss"!

At the time, that translated into Angus H. McLachlan, the urbane General Manager of John Fairfax Ltd and a director of Associated Newspapers Ltd, then publishers of this magazine. Arrangements were duly made for Harry Carter to meet Selwyn Sayers outside the Broadway building at a certain time, and be conducted to the management offices on the top (14th) floor. This floor was referred to sometimes as 'Heaven'; at others as 'The Mausoleum', prompted by its demurely panelled wooden walls, acres of carpet and pervading silence.

Ordinary mortals entered only when bidden, with bated breath and respectful countenance.

When Harry arrived at the front entrance of the building, he'd come direct from his shop in his work clothes: non-descript trousers, odd shirt and socks, old style tennis shoes, and carrying a time worn Globite case. Thus clad, he was ushered into the Management lift to the 14th floor and thence into the GM's sanctuary.

The reason for the visit was duly explained, but Harry seemed determined to make one particular point. Picking up the Globite case, he unclipped the lid and emptied the contents all over McLachlan's desk — a great untidy pile of banknotes! This with an insistence that "I've got the money. I can pay my bills, better than you all seem to think!".

Who said what next is not part of the story. All I can say is that Harry Carter's adverts continued to appear, and readers complaints about poor service seemed to diminish. Mission accomplished!

It was tough, but there just wasn't room inside for this lot. Visitors to A.C.E Radio were often dismayed to see surplus gear standing outside in the rain.

In 1970, Joe Ellison became the owner of A.C.E. radio and it was from him in the 1970s that John Rich picked up most of the information and his impressions relating to the disposals era in Australia.

What became of A.C.E.?

So what happened to A.C.E. Radio? John says that Joe Ellison decided ultimately to sell the business and move out of Sydney. Seeking further information, I asked repeatedly where Joe went and where he is now, but no one appeared to have the answer. I simply don't know.

Both John Rich and Selwyn Sayers said that the business had been brought by a Paul Fullagar, who moved it 'lock, stock and barrel out Manly way'. In so doing, he forfeited the customers who had habitually dropped into the Marrickville premises 'to have a sticky' — but he didn't attract an equivalent number from his new locale. As such, the venture was a failure.

Paul Fullagar, I was told, donated the best of the antique equipment to local schools, etc., and consigned the apparently unsaleable residue to the tip.

John Rich tells me that the A.C.E. cottage has been replaced by a modern building. But maybe, just maybe, some young secretary on the site may one day glimpse a shadowy figure in workclothes and tennis shoes, soldering iron in hand, bending over a radio chassis... ❖

FORUM

Conducted by Jim Rowe

The fury of some radio amateurs, when their wallets are threatened...

There was a decidedly 'heated' response to my editorial in the March issue commenting on the SMA's proposal to increase amateur radio licence fees, as I noted last month. I'm reproducing here a sampling of the critical letters and faxes which streamed in, so that no-one can claim I'm not giving my critics a 'fair go'. In any case, I think you'll find that the missives reveal quite a lot about the attitudes of at least *some* members of the amateur radio 'fraternity'.

As I mentioned in the March editorial itself, I expected to be a bit unpopular with at least some amateurs when it was published. That's because I've learned from past experience that in this kind of situation, quite a few hams will regard you as 'the enemy' unless you take a totally one eyed, pro-ham position. And there are times when it simply isn't easy to be this narrow and partisan in outlook...

Still, I must confess that in this case I *was* somewhat taken aback by the level of personal abuse in some of the missives. Clearly the people concerned were very upset, and anger overcame whatever good manners and objectivity they might normally have displayed.

As you'll see from some of the letters I'm reproducing, some people didn't hesitate to accuse me of bribery and corruption. One accused me of single-handedly engineering the near destruction of amateur radio; others have demanded my resignation, while yet another sought to get me fired. To paraphrase an old saying, it seems that Hell hath no fury like some amateurs, when their wallet is threatened!

It's interesting that the main thing most critics siezed upon was my small error regarding the lack of rises in amateur licence fees over the last 10 years. As they all rushed to point out, I was certainly wrong here — the fees *have* risen in that period from $23pa to $37pa, as I noted last month.

It was clearly an error, although as various people have commented, not really a major one. But from the huge amount of heat generated, it's clear that the error was important not so much in its own right, but for the opportunity it gave the critics to 'have a go' at me...

By the way, I gather that as well as becoming the target for quite a stream of this direct 'hate mail', I was also the subject of numerous 'flaming' messages on the amateur packet radio network. I'm told that some of these messages were fairly nasty, too — even for the packet radio network, which has some notoriety in this regard.

Mind you, I've been told that some of the packet radio messages which circulated about senior staff members in the Spectrum Management Authority were particularly nasty — so compared with them, I probably escaped quite lightly. It looks as if some people lose all sense of propriety and good manners, when they believe they can 'hide' behind a computer keyboard rather than confront people directly...

I'm sure that most people in amateur radio wouldn't dream of descending into this type of behaviour, and that those who *do* make up a tiny 'ratbag minority'. This makes it all the more unfortunate that these people are much more visible than the well-behaved majority, and lower the image of amateur radio in a manner quite out of proportion to their numbers.

For example I believe that some of the nastier packet radio messages about SMA staff have been shown to both the Minister for Communications and his colleagues in Cabinet — which would almost certainly have done much more to tarnish the image of amateur radio in *their* eyes, than any small error in my own editorial.

The critics speak

But let's begin. Probably the first critical letter to arrive, following the publication of my March editorial, was this one from Mr Will McGhie VK6UU, of Lesmurdie in Western Australia:

Being a long time consumer of Electronics Australia since 1966 and a radio amateur, I was disappointed in your editorial on the large increase to amateur licence fees.

There has been considerable amounts of misinformation and you have succeeded in spreading it even further. To quote from your editorial, 'Amateur licence fees haven't risen for about 10 years'. Wrong...!!!

It even surprised me, when I went back over my past licence fee costs:

1995	*$37*	*1987*	*$26*
1994	*$36*	*1986*	*$23*
1993	*$35*	*1985*	*$21*
1992	*$35*	*1984*	*$19*
1991	*$35*	*1983*	*$19*
1990	*$34*	*1982*	*$15*
1989	*$32*	*1981*	*$14*
1988	*$28*	*1980*	*$10*

Even though the print was a little hard to read on some of them and may not be spot on, I hope you get the message. You are wrong. In fact I would have at a guess that amateur licence fees have increased faster than the CPI...!

Other aspects of your editorial are also incorrect, such as 'Prolonged negotiations between the WIA and the SMA that the new fee structure has been whittled back'. Wrong...! Go and ask the WIA if they had prolonged negotiations with the SMA over the new fee structure.

And also your comments on the amount of spectrum space amateurs have access to is misleading. Most of it is on a secondary basis, and is only ours until someone else wants it.

By my calculations only 20.47% of frequencies allocated to amateurs are on a primary basis. In the region from 1.8MHz to 148MHz only 6.1% is primary amateur. And this figure is distorted high due to the unwanted 1.7MHz at 28 to 29.7MHz.

And your comment on what is happening in other countries may be true about

commercial users paying more equally for what they use, but it is not true for Amateurs in most if not all other countries. I gather you have not seen the comparisons done with other countries. Packet radio has been full of this information.

All in all Jim, very poor journalism. Swallow hard, check your facts and then write a retraction.

As you can see, Mr McGhie was clearly unhappy, but was at least fairly civil. It became clear later, however, that he had put a copy of his letter on the packet radio network - and it was perhaps not coincidental that many of the letters and fax messages from other critics turned out to have very similar passages.

You'll notice that Mr McGhie shows us what has happened to licence fees over the last 15 years, just to emphasise his point.

As I mentioned in last month's editorial, I believe it's not in the best interests of amateur radio to expand on the reasons for the negotiations between the SMA and WIA having been delayed; in describing them as 'prolonged' I was wrong, but this was basically because I was trying to be charitable to the WIA.

One further point, before we go on. Despite what Mr McGhie and many of his fellow critics seem to think, my reference to the amount of spectrum 'real estate' allocated to amateurs was based only on their *primary* usage rights. I was not counting the bands where amateurs have only secondary rights.

The fact is that below 30MHz, in the HF bands, amateurs have primary rights to 3.025MHz of spectrum; below 150MHz, the figure grows by another 6.0MHz, to a total of 9.025MHz. And this is in absolute terms far more than just about all other users, apart from the military.

Many of my critics have tried to minimise this, by talking about percentages and whatever; but the fact remains that amateurs DO have access to a sizeable amount of space, in a spectrum that's coming under more and more pressure...

Moving on, here's another example of the faxes from critics who were quick to sieze upon my error regarding the licence fee rises. It came from David Horsfall VK2KFU/VK2ZTB, of Wahroonga in NSW:

I refer to your editorial on page 5 of the March issue of EA. Whilst you are certainly entitled to your opinion, no matter how unpopular it may appear to make you, you could at least get some basic facts straight.

I quote: 'Amateur licence fees haven't risen for about 10 years...' I don't know who's been paying your fees for you, but mine have risen by about $1 per year in the twelve years that I have been licensed. Is this some new meaning of the phrase 'haven't risen' with which I was hitherto unfamiliar?

As you can see, Mr Horsfall was brief and to the point, although he couldn't resist that little touch of sarcasm.

More constructive

Rather longer, and somewhat more constructive, was this fax from Dr Murray Kelly VK4AOK, from Graceville in Queensland:

I suspect your editorial in the March 1995 issue which was in favour of increasing Amateur licence fees was written to stir the possum. After all, the last good response and ensuing bun fight in Forum was from the Amateurs too. Here is my $.02 worth.

The primary space in the spectrum between DC and 24GHz occupied by the Amateur Service totals 9.05MHz or .038%. Allocations that are secondary are worth diddly-squat commercially and any amateurs working at 24Gigs and above deserve a medal, not a fee

rise. Secondary allocations are usually shared with the military on a 'good neighbour' basis and if the military can't accommodate that, then God help us if they ever meet a determined enemy.

Assuming the Spectrum Management Authority (SMA) collect about $35 from each Amateur station, and there are about 18,000 of them, they raise $600,000 for those 9.05MHz or 6.6 cents/Hz. If they were to raise 6.6 cents/Hz over the whole 24GHz, they would be collecting $1.6 billion dollars for the Australian taxpayer. I doubt they are.

The SMA questions that the Amateur Service should have 'so much' spectrum, as if the Amateur bands were some sort of wastelands. The question that is never raised is, 'what do they use the spectrum FOR?' That would provoke an answer too embarrassing by far. Amateurs are raising Australia's electronics awareness and education, generally, and at zero cost to Canberra. The Government is doing nothing to help despite the rhetoric of 'The Clever Country'.

I suggest a more realistic view would be that the Amateur bands are the National Parks Reserves of the radio spectrum. Like the land itself, the Government doesn't actually own the stuff but is the people's management body for that resource.

It has been said that National Parks should be set at 10% of the land area. Australia is 'way behind' other nations here but the primary spectrum allocated to Amateurs is even worse at .038% of 24GHz. The Amateur has paid his entry fee to this park by studying in his own time and at his own expense (the exams don't come cheaply any more) and supplying his own equipment. There is a good case there for following the US lead and dropping fees altogether. It would make more sense to stop wasting money collecting the $600,000 and down-size the staff of the SMA.

I disagree with your comment that the typical Amateur uses transceivers etc. costing over $2000. Most of my acquaintances use second-hand gear, which often sport those FETs with pilot lights. In any case, would you condemn us to using the equivalent of a pencil and paper in this age of $2000+ PC word-processors? Not every home has a PC yet, but that day approaches us quickly. Why shouldn't we Amateurs have nice things, too?

For some reason it is commonly assumed that all amateurs are inventors and if they are not coming up with new and bright ideas all the time, there must be something wrong. On the other hand it is never expected that professional engineers should all be inventing madly nor indeed journalists should write literary masterpieces every week (when did you write your last prize novel?). The Amateur environment serves other purposes. The inventive are given a milieu to try their ideas with like minded people, something that would be difficult in any industrial workplace unless that person was involved in the R&D Department. Even I have a patent allocation for an RF device even though it is miles out of my work field. Have you?

It surely must be significant that Japan has a ratio of 20:1 with Australia with regard to Amateurs per head of population. In Japan there is nearly one Amateur for every 50 people. Here, it is one in a thousand. It would be hard to deny that this just might have something to do with that country's world pre-eminence in the electronics field. The youth are encouraged into radio, not discouraged by high licence fees. Amateurs should be there to help Australia as it staggers down the road to Mr Keating's Clever Country. Raising fees won't help to encourage our youth into technology via Amateur radio.

Notice that I have not mentioned those old chestnuts, Civil Emergencies and message handling. The SMA will never be permitted to take these aspects of Amateur radio into account when determining fee structure. For any Official Body to admit that its preparedness for emergencies was partly dependent on the good-will of radio Amateurs would be tantamount to admitting negligence in their planning, ergo, it couldn't happen. Incidentally, the term Disaster Planning is an oxymoron. Check out 'disaster' in the Macquarie Dictionary.

In summary:

The Government, through its SMA, should be encouraging its citizens to migrate to the Clever Country by supplying them with the necessary tickets. Amateur Radio is one of those tickets and should be given out free of charge.

As you can see, Dr Kelly came up with quite a few constructive points. He still seeks to minimise the spectrum space allocated to amateurs on a primary basis, and probably takes the 'National Parks' analogy a little too far, but otherwise I can agree with quite a lot of what he says.

Just for the record, though, I haven't written a single prize-winning novel, nor have I any patents to my name. You have me there, Dr Kelly, although the relevance of these points to the current discussion escapes me.

Quoted in Parliament

Now before I show you the remaining missives, I should perhaps note here that the *real* hate mail didn't really start to arrive until there was a further development. On March 9th, a few sections from my March editorial were quoted in Federal Parliament by the Member for Capricornia, Ms Marjorie Henzell, during a debate on the Radiocommunications (Transmitter Licence Tax) Amendment Bill 1994.

Perhaps it was sheer coincidence, but one of the sections quoted was — you guessed it — the bit about licence fees not having risen for about 10 years. And as Ms Henzell was using this in a speech arguing in favour of the proposed rise in amateur licence fees, this *really* made my critics upset.

Here's a little fax that turned up soon after from Richard Murnane VK2SKY, of Dee Why in NSW:

Well, Jim, I hope you're happy... I see, from the Hansard for 8 March, that your ludicrous editorial assertion, that Amateur licence fees haven't gone up in the last ten years, has been passed off as fact in the Federal parliament.

I fully expect you to publish a full retraction of your false claim, and to ensure that such retraction is voiced in parliament when the debate on the radiocommunications amendment bill resumes in a few days time, or I — like many others I expect — will not be buying your magazine in the future.

As you can see Mr Murnane was again brief and to the point, although how he expected me to ensure that any retraction of mine was voiced in Parliament, I'm not sure. Presumably since I have no power to control Parliament, we've now lost him as a buyer of the magazine...

Here's another fax along similar lines, which came from Mr Doug Rickard VK4ZDR of Upper Coomera, in Queensland:

I have previously (22-Feb-1995) registered my disappointment with the incorrect and misinformed editorial which appeared in the March 1995 Electronics Australia.

Now that your misleadlng editorial has been used in Federal Parliament to support the SMA case against amateurs, I hope you are satisfied.

All alone, and in one stroke, you have done more to damage amateur radio in Australia than has happened in the previous 50 years. In one go you have erased all the good work that the maga-

zine and its predecessors have done for decades towards amateur radio. I hope you are now happy. It might now be an appropriate time for you to tender your resignation before you do any more damage to our cause.

As you can see, Mr Rickard goes somewhat further than many others, and was probably the first to suggest that I should resign. Note that like many of the other critics, Mr Rickard also uses the phrase 'the SMA case against amateurs' — with its implication that the SMA has somehow been deliberately targeting radio amateurs. There's no evidence for this at all, of course; in reality, it's clear that the people in the SMA have merely been doing the job they've been given by the Government, on our behalf.

Even longer bow...

Moving on again, though, here's an example of a letter which went somewhat further that those before it, and drew and even longer bow with its accusations. It came from Mr R.J. Robinson-Pedder, VK4BBA, of Currimundi in Queensland:

Being a customer of Electronics Australia for some years now, I was extremely disappointed in your very biased editorial on the massive increases in TAX to the radio amateur licence fees by the SMA. The only country in the world to do so.

Everyone has the right to their own opinion, including you, but it is all too apparent that you have been brainwashed by the SMA by publishing inaccurate data, which you have succeeded in spreading further. Even into the house of Representatives. Gee whizz you must be feeling real proud. What a pity you didn't get your facts right... Ho hum! What else could one expect these days from the media.

May I suggest that before you again put pen to paper, make sure you have all your facts right, sunny Jim, before you go to press. Not to print a whole lot of propaganda doled out by a very inefficient department such as the SMA who are trying desperately to save face and credibility.

If you believe every word the SMA utters as gospel then you must be pretty gullible. Your article is typical of the chequebook journalism we are plagued with in Australia and the rest of the world these days. Perhaps you are trying to make a name for yourself. Rest assured you sure have done that within the amateur fraternity. So be a good boy, go back and get all your facts right. Then go to press. The rest of the amateur world here in Australia need you and your magazine like a hole in the head. A term which was once coined during WWII was QUISLIN [sic], *which seems to be very apt.*

For instance you stated that amateur licence fees have not risen in ten years. Wrong!

1995 $37 1990 $34 1986 $23
1994 $36 1989 $32 1985 $21
1993 $35 1988 $28 1984 $19
1992 $35 1987 $26 1983 $19

It is easy to see the fees have increased faster than the CPI...

Your editorial was also incorrect in stating that there had been 'Prolonged negotiations between the WIA and the SMA and that the new structure and fees had been whittled back'. Not so. Ask anyone other that the SMA and you will get a different story. Try for starters asking the WIA about the prolonged talks...

Your comments in respect to the amount of spectrum space amateurs have access to in Australia is very misleading. May I point out that the majority of them are on a secondary basis and only ours until the big boys with pots of money decide to take them off us... The multi combines such as Telecom, and all branches of the media can of course increase their charges to offset any tax the SMA place on them. Who do you think will pay for those increases? In the long run the general public and seeing that us mere amateurs fail into this category, we pay again. Great idea according to your philosophy.

If you take time and do some calculations sunny Jim, you will end up with a figure around the 20.5% of frequencies allocated to amateurs, which are on a primary basis. Also, you will find that from 1.8MHz to 14MHz the primary frequencies for amateurs evaluates to approximately 6.1%. This can be further reduced due to the unwanted 1.7MHz at 28MHz to 29.7MHz.

Furthermore your comments on what is happening in other countries is true regarding the big commercial boys having to pay more for what they use. As I have said before they can redress the issue by obtaining lots of lucre from advertising, or by increasing their charges to users of their systems. This is not true in respects of all amateurs, even a novice knows that your licence does does not allow you to do so.

For myself I have held an amateur radio licence for nigh on forty years, having held the calls G3NEE and MP4BA and now currently VK4BBA. During my working life, I have been employed in the radio and telecommunications industry, as well as the aircraft industry. Here I worked on such projects as Concorde, Tornados, Hawks (not the Bob type), Ba146, Air Bus, Shuttle and satellite navigational systems. As an amateur I have been able to contribute many ideas into these industries and projects. In fact amateurs were encouraged into these industries in the UK. In British Aerospace there were over 200 amateurs employed in that industry alone.

We are constantly told by a certain gentleman in high places that Australia is the cleaver [sic] *country. So clever that he puts a TAX on amateurs.*

Being a returned serviceman, may I also point out to you that there are many of us who are on a very limited budget nowadays. Many amateurs here in Australia, as well as overseas, are invalid, some are even blind. How do you think they will cope with this massive TAX on their hobby, sonny Jim? Many will just have to give it away. Do you think that is fair? Or will it, as in your case, be 'Hard luck Jack, I'm alright...'

Now come on, sunny Jim. Do the right thing. Go back to the keyboard, obtain all the correct facts. Take a deep breath and then write another epic. This time make it a retraction and try to put the score right.

I for one will be 'OUTING' from your magazine. You can bet your bottom dollar that I will not be the only amateur to do so after your editorial... Perhaps with luck your boss will see the errors of your ways. Now there is something for you to think about.

Well, Mr Robinson-Pedder didn't hold back much, did he? He didn't quite get the spelling right, but I'm likened to the despised 'quislings' who sided with their country's enemies during WW2. And for good measure, I'm accused of being heartless and uncaring about amateurs who may be blind or infirm, and now unable to pay their amateur licence fee.

I found this all pretty insulting and over the top, I must confess. However I *did* get a chuckle from Mr Robinson-Pedder's other inadvertent spelling error — the one about Australia being the 'cleaver' country. In view of his own hatchet job on me, the term seems rather appropriate...

Incidentally you may have noted that like Mr McGhie, Mr Robinson-Pedder also describes the 28 - 29.7MHz amateur band as being 'unwanted'. I wonder if all amateurs would take that view, and would be happy for hams to lose that band? I would have thought that this spectrum segment would have significant value for anyone involved in serious investigations into propagation, but perhaps I'm wrong here too.

Letters to Federal's GM

Moving on again, though, here's a pair of letters that in many ways took the prize for escalating the level of personal abuse right over the top. They both came in the one envelope from Mervyn V. Millar, VK5MX, of Croydon Park in South Australia, who directed them initially to the general manager of *EA*'s owner, Federal Publishing Company. Here's Mr Millar's first letter, directed specifically to the GM:

Dear Sir or Madam,

Please find (Enclosed) a copy of a letter sent to the Managing Editor of Electronics Australia, Jamie Rowe.

I am one of many who are deplored at the attitude of this 'EDITOR' although he is entitled to HIS opinion he at LEAST wants to get his FACTS RIGHT Before shooting his mouth OFF.

This is NOT the first time EA has put out erroneous and MISLEADING INFORMATION. Space did not allow me to go into the other details of his editorials which were also disputed, and I know of a number of other Amateurs who have written to him about the same editorial/s.

Rowe should be severely reprimanded or removed from the position of Managing Editor in the same way you removed another employee (last year) for financial mismanagement, because this is JOURNALISTIC Mismanagement.

As you can see, in this letter Mr Millar was basically just seeking my removal. (By the way, the General Manager was mystified by that cryptic reference to someone who had supposedly been 'removed' last year, for 'financial mismanagement'. I found it pretty puzzling, too.) But he became rather less pleasant in the second letter, which was directed more or less at me:

It was with much DISPLEASURE I read your disgusting Editorial in March EA. Firstly I have been an Operator for the past (17) Seventeen years. In that time the fees have RISEN steadily at an average of $1 - $3 per year.

As I recollect my first licence was around $4 and a friend of mine used to pay 2/6 pence in the days before the 1939/45 war.

I suppose you have a SALARY in the range of $50,000 to $150,000/year, so YOU would NOT miss the rises IF in fact you had a call sign. (ZLO? - Can't do the Morse???)

Most AMATEUR Radio operators grew up with Electronics Australia during the 1940's to 1980's under the expert help and guidance of a predecessor of yours, Mr JOHN MOYLE did you know him?

Rest assured I will NOT be subscribing to EA in the future, nor will I buy it in the shop. Like all small businesses you forget where your beginnings were, like many other small businesses, you'll get so big and big headed you'll eventually go BROKE. Remember it's those little experimenters and hams that have put EA on the MAP.

I wonder if you are related to [name deleted] *and if you get your information from him or does he get his information from you? Both of you dribble Bullshit very easily. How about the time you were plugging EA subscriptions, promising loads of NEW IDEAS Ham radio, NEW staff etc. Great magazine, you said. My how the High and Mighty Jim Rowe Magazine has fallen to the lowest depth.*

I'm Jim Rowe, Wealthy, Healthy & Wise. I'll NEVER need anything... One never knows look at Elliot, Skase, Bond, WAinc, Et Al.

C U Next Tuesday when you get the old foot out of the MOUTH.

Hmmm — as you can see, Mr Millar became rather excited there for a while. So much so that he lost me in places, like that crack at the end about 'next Tuesday'. I half expected him to appear on the day with a shotgun, but mercifully he didn't...

By the way, the person whose name I've deleted (to avoid any possible legal repercussions) is neither related to me nor even known to me, so it's presumably just someone else who has aroused Mr Millar's ire.

To set the record straight, and although none of these points is relevant, here are the answers to some of his questions:
(a) Yes, I do have the callsign VK2ZLO;
(b) Indeed, I couldn't pass the Morse test; and
(c) No, I didn't know John Moyle. I would have liked to have met him, but unfortunately he was terminally ill in hospital when I joined the magazine as a very junior staff member in early 1960, and died soon after.

I see that Mr Millar believes I'm in the same league as some of the former high-flying entrepreneurs he quotes, presumably because of my supposed high salary. Perhaps if this were true (it isn't, of course), his allegations might have been less hurtful than they were...

Final sample

To draw this month's airing of my claimed transgressions to a close, here is the follow-up letter that turned up from my original critic Will McGhie VK6UU, following the speech made by Ms Henzell in Parliament:

I have just finished listening to the debate in Parliament over the SMA's increase in licence costs to Amateur Radio operators. You may be interested to know that your name was mentioned several times by the Government spokesperson, in relation to the March editorial you wrote.

The whole editorial was read in various parts and you were portrayed as being in support of the Government's position that the increases where justified. It is unfortunate the misinformation that was contained in your editorial was used by the Government as statements of fact! In particular the 'no increase in amateur licence fees in the last 10 years'.

Your lack of good journalism has done the amateur fraternity considerable damage. I would ask you to write to the Government spokesperson who used your editorial as supporting 'facts' and inform her that your information is incorrect.

This misinformation trail has gone full circle from SMA, to you, to the Parliament. I will be writing to her to inform her of the errors in fact in your editorial.

I tried to contact you by phone but you failed to return my call. This letter has also been circulated via the Amateur Radio Packet network, and a copy sent to the WIA.

As you can see, while still relatively calm Mr McGhie was now also claiming that I had done considerable damage to the amateur radio 'fraternity' (which seems a particularly ironic term, in view of the actions of many of his colleagues). There also seems to be an implication that I was somehow linked in a conspiracy to disseminate misleading information, which is quite false.

Perhaps I should note here that once I *had* learned of the errors of fact in my March editorial, I immediately arranged to publish a correction in the next available issue — which happened to be May, as the April issue had already been printed. As this correction would not be published until well after the debate in Parliament was due to be resumed in late March, I also decided to sent letters advising of my errors to both Ms Henzell and Senator Alston, the Opposition spokesman for Communications.

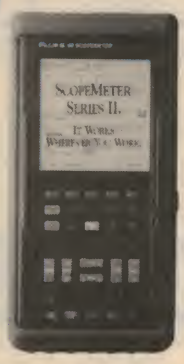
Copies of these letters were supplied to the President of the NSW Division of the WIA, Mr Michael Corbin VK2PFQ, and Mr Corbin read them out during the Division's Sunday morning broadcast of March 19, to inform his listeners of my efforts to compensate for any damage

(Continued on page 73)

STOP PRESS
Ask about NEW 100MHz ScopeMeter Model 105

You've chosen the best – You've chosen Fluke... Now let Obiat help you make the right Fluke choice!

ScopeMeter® Series II



ScopeMeter Series II is a battery powered, combination scope and meter designed for measurements on-the-go. Just push the MEASURE MENU button. Select one of 30 measurements, and ScopeMeter Series II automatically configures itself to take the desired reading. Manual controls are still there, but ScopeMeter Series II is so fast and easy, why use anything else?

FEATURES	91	92	96	99
50 MHz Bandwidth	1 Ch.	2Ch.	2 Ch.	2 Ch.
Continuous Autoset	•	•	•	•
Automatic Setups	•	•	•	•
Long Term Recording	•	•	•	•
DMM + Waveform	•	•	•	•
True RMS Volts	•	•	•	•
Continuous Beeper	•	•	•	•
10 ns/div to 60 s/div)	•	•	•	•
1 mV/div to 100V/div)	•	•	•	•
Digital Trigger Delay	•	•	•	•
RPM, Temp functions	•	•	•	•
Current Clamp Scaling	•	•	•	•
Scope Cursor Readings	-	-	•	•
Glitch Capture - 40 ns	•	•	•	•
Screen Memory	-	-	5	10
Waveform Memory	-	-	10	20
Set-up Memory	-	-	20	40
Waveform Math & Filter	-	-	-	•
Signal Generator	-	-	-	•
Component Tester Output	- Volts & Current			•
RS-232-C Interface	•	•	•	•
Printer Output	-	-	•	•
Backlit Display	•	•	•	•
Help Function	•	•	•	•

There's a ScopeMeter Designed For You.

Model 91: Flukes lowest priced ScopeMeter the 91 is a single input channel digital oscilloscope. The 91 features an analog-like backlit display, continuous autoset, a full-featured true rms multimeter with special modes, frequency counter, direct access measurement menu, Trendplot™, current clamp scaling, and on-line help messages. Screen transfers can be made to a PC (optional interface cable required). Sealed against the elements and protected by a shock resistant holster with battery or ac line power, the 91 works wherever you work.

Model 92: As the 91, plus a second channel.

Model 96: The 96 adds measurement cursors and memory functions – save screen images, capture waveforms, and enable front panel setups. Like the 92, screen transfers can be made to a PC. And screen readout(s) and waveform(s) can now be transferred directly to a printer.

Model 99: The 99 adds waveform math/filter capability, a signal generator, component tester, and more memory storage for screens, waveforms and setups. It also offers remote operation over the RS-232 interface cable.

Limited quantity of ScopeMeter Series I available at heavily discounted prices. Call us!

New 860 Series Graphical Multimeters

Fluke Graphical™ MultiMeters represent a whole new category of test instruments that combine the industry's most advanced multimeter capabilities with the visual power of waveform display, in-circuit component testing, logic activity detection, trend plotting etc., together in one easy-to-use, handheld instrument.

Fluke's 860 Series is a family of three GMM™ test tools that are the first high-accuracy, high-performance multimeters combined with analog, digital and graphical displays. They allow users to view information in the form best suited for their application. And for the first time, this graphical power is accessed through an easy-to-use, rotary switch familiar to many multimeter users. This virtually eliminates long learning curves.

860 Series GMM test tools offer the highest accuracy (0.025% dc) in a handheld meter. They feature 32,000-count (4 2/3 digit) resolution, a dual digital display that gives users extra information and an Analog NeedleGraph™ display. Meter mode enables users to directly measure Vac/dc, Aac/dc, ohms, conductance, capacitance, frequency, duty cycle, pulse width, period, and dB. The GMM test tools also offer a new AutoDiode™ feature (patent pending).

Waveform Display, with up to 1 MHz signal bandwidth, provides a clear picture of noise, waveform distortion, intermittent failures and glitches. The AutoGraph™ display setup automatically scales voltage, time-base, triggering and position for fast and easy test setups. Manual setup or external triggering are also available.

TrendGraph™ plots high resolution meter readings for up to 30 hours, in intervals from 1 second to 15 minutes, to detect such anomalies as power sags/surges and droops.

FEATURES	863	865	867
Basic dc accuracy	.04%	.04%	0.025%
30 mA dc accuracy	0.1%	0.05%	.05%
Current ranges	4	6	6
Frequency counter	2MHz	>10 MHz	>10 MHz
AC bandwidth (-1 dB)	300 kHz	300 kHz	300 kHz
Display bandwidth (typ)	1 MHz	1 MHz	1 MHz
Logic activity	-	•	•
Component test	-	•	•
LCD backlight	-	•	•
Internal battery charging	-	•	•
Waveform memory	-	•	•
Alkaline batteries	•	•	-
Battery eliminator	-	•	•
NiCad batteries	-	-	•
Optically Isolated RS-232 cable & adaptors			•
FlukeView 860 software	-	-	•

80 Series Analog/Digital Meters

Fluke's 80 Series 4000-count DMMs provide high performance measurement of dc/ac voltage and current, frequency, duty cycle, resistance, conductance and capacitance. All three meters are EMI shielded and come with a splash-proof and dust-proof case. A protective holster enables safe use under harsh operating conditions.

Taken as a family, the 83, 85 and 87 cover 40 ranges – from 400 mV to 1000V for dc/ac voltage and 400 µA to 10A for dc/ac current; 400Ω to 40 MΩ resistance; 40 nS for conductance; capacitance of 5 nF - 5 µF; and frequency from 99 Hz to 999.9 kHz.

FEATURES	83	85	87
Digital Display	4000	4000	4000 19,999 in high res. mode
Analog Readout	43-segment Bargraph	Analog Pointer	
AC/DC Voltage (400 mV to 1000V)	•	•	•
AC/DC Current (400 uA to 10A*, All Fused)	•	•	•
Resistance	•	•	•
Freq. & Duty Cycle	•	•	•
Capacitance	•	•	•
True-RMS Vac, Aac	-	-	•
1 ms Peak Hold	-	-	•
1000Vrms Input with Input Alert™	•	•	•
MIN/MAX Av. Recording Mode with MIN/MAX Alert™	•	•	•
TouchHold & Rel.	•	•	•
Splash & Dust Proof Holster w/Flex-Stand™	•	•	•
EMI Shielded	•	•	•
Backlit Display	-	-	•
UL 1244 Listed	•	•	•

** 10A continuous, 20A for up to 30 seconds*

Choosing the Right Meter for you

Accuracy of Vdc/ac and Adc/ac is greatest in the 85/87: 0.1% for Vdc, and 0.2% for Adc ; the 85 has greatest accuracy for Vac (0.5%) and Aac (0.6%).

Model 83: With a 4000 count display that updates 4 times per second, the 83 has dc accuracy of 0.3%. It also has a 43-segment, high resolution analog bargraph, TouchHold™, Relative, MIN/MAX Average Recording, MIN/MAX Alert™, and Zoom.

Model 85: As the 83, but increases Vdc accuracy to 0.1%.

Model 87: A true-rms ac meter with a 4 1/2-digit high resolution mode (19,999 counts), the 87 offers 1 ms Peak Min/Max Hold and a high resolution analog pointer. The 87 has a backlit display, enabling clear readings in poorly lit locations.

FLUKE
Serious Tools for Serious Work.

We are factory trained to advise on your requirements for general purpose Test & Measuring Instruments. Ask about our Account facilities and special arrangements for Education and Government Departments. Express delivery can be arranged throughout Australia and South Pacific.
Have you got our FREE 36 page catalogue?

READER INFO NO. 14

OBIAT PTY LTD
129 Queen Street, (P.O.Box 37) Beaconsfield NSW 2014
Tel : (02) 698 4111 Fax : (02) 699 9170

THE SERVICEMAN

The car that produced wow and flutter in cassette players!

Since stories about generators and alternators seem to be quite popular, I'm presenting a couple more for your edification this month. One concerns a simple, but surprisingly hard to track down problem in a car, which made it produce wow and flutter in two different radio cassette players. The other is about a diesel generator set that wouldn't start...

One of the items in last November's column, about the old Volkswagen with the reversed battery polarity, has generated (no pun intended) a steady stream of stories about generators, alternators and general automotive electrical subjects. This month we continue the subject with a story from Keith Walters, of Lane Cove in NSW. Keith's tale is about a queer problem that took him something like eight years to solve, and is still showing up in other vehicles, some 20 years later!

Here is what he has to say...

*We've all encountered the situation where, after hours, days or even weeks of our fruitless toiling over an obscure fault, some smart-alec wanders in, casually points to something apparently totally unrelated and says: "It's that!" And as often as not, it *#$%?@!!- well IS 'that', too! An honest smart-alec (or one who knows what's good for him) should of course have the decency to reveal how long it took HIM originally to find the fault!*

My personal favourite story in this vein was a former colleague who, many years ago, had been struggling with a Thorn 3504 colour TV, off and on for some weeks. This model was actually the old British 3500 chassis, modified for Australian conditions by fitting a power transformer and a VHF turret tuner.

Unfortunately they didn't do a very good job — the sets were prone to instability on channel '0'. There was some sort of regeneration effect that narrowed the IF bandwidth to the point where colour and sound couldn't be obtained at the same time. In extreme cases it would go into oscillation, blacking out the screen.

Anyway, I'd moved to another city about a year before this, and he'd mentioned the problem as a aside on a Christmas card he sent me. ('That @?#?!! 3504 is still driving us up the wall, etc. etc.') So by return mail, I put him out of his misery.*

The secret was that Thorn seemed to be very partial to using a particular type of free standing air-cored inductor, using some sort of fabric-covered wire treated with wax so that the turns didn't unravel. (Old hands will know the ones I mean). There was one of these mounted on top of the tuner. All you had to do was twist it around 90 degrees and all the faults would disappear! (So how long did it take ME to find that one first time? Don't ask...)

There are many other stories: The dry joint on the chassis heater connection on old Admiral valve sets, that made EVERYTHING crook; the thick-film module in the Thorn 4KA vertical board that caused poor horizontal hold while not affecting the vertical circuit in any way at all; 'No picture' on the same chassis, caused by a slug falling out of a coil on the EHT regulator and getting itself lost; the 4.7uF electro on the CRT base board of numerous Sanyo models, causing a dark picture — I'm sure you all have your favourites.

Baffling fault

Anyway, recently I was able to help a non-technical friend with a baffling fault in his car. While he was greatly impressed by the way I was able to identify the problem straight off (without even seeing the vehicle!!), I had to admit that it had taken me the best part of EIGHT YEARS to do the same for my own car! (I won't tell you what his problem was straight off — see if you can work it out...)

It all started nearly 20 years ago, when I worked for a well-known electronics service company. They were having a clean out in the radio workshop and I was given a faulty car radio-cassette unit that had been an unacceptable quote and was never collected.

Now in those days, car radio-cassettes were still relatively uncommon and quite expensive, so I was surprised to find that all it seemed to need were new output transistors. Two BD237/238 pairs were promptly fitted and that seemed to be that.

It was a reasonably up-market unit, with proper locking fast forward and rewind (in those days a lot of them just had a non-locking 'slightly faster' forward). The tuner was admittedly a bit of a weirdo — it had two bands: one AM of course, and one SHORTWAVE band!

Why they thought anyone would want to listen to shortwave while travelling in a car was beyond me, unless it was so that less-informed purchasers might mistake it for a more expensive to build AM/FM unit! (There were no FM broadcasts in Australia at the time, so they wouldn't have been any the wiser).

Anyway, all this is just by way of saying that it was quite a respectable unit, certainly worth spending a bit of time and money on. Which was why I was surprised that the original owner hadn't accepted the fairly modest quote.

The radio worked well (even on shortwave!) and with a pair of 6"x 9" speakers mounted in the back of my Fairmont station wagon, gave what was for those days a really impressive performance.

Unfortunately the cassette unit was less successful. It worked OK on the bench and when the car was stationary, but developed moderate (sometimes severe) wow and flutter when the car was in motion. I was able to source some replacement rubber components, but these didn't seem to make much difference.

It wasn't all THAT bad — on sealed roads the problem was often barely noticeable, but it could be really annoying on bumpy roads. I was beginning to suspect that the original owner mightn't have been so silly after all.

I put up with it for about five years, then when FM broadcasts started I replaced it with a new radio-cassette (with a REAL FM band!). The old one I gave to an impecunious acquaintance, to put in his work truck.

Alas, although the cassette player in the new unit was a considerable improvement over the old one, it STILL produced noticeable wow and flutter.

Even worse, the old one now performed faultlessly in its new location, despite the truck's rough and ready suspension (and the driving skills of its owner).

I wondered if there might have been something wrong with my battery voltage, although there was never any trouble starting. The voltage certainly measured OK when the car was idling, and I never got round to trying the more complicated hookup needed to test it on the road.

Then one year I was given a dash-mounting ammeter/voltmeter unit, for a birthday present. I duly installed it (it simply connected to the battery terminals), and driving over a bumpy road for a while showed nothing amiss. (There's a clue in there...) Anyway, as I said, the problem wasn't all that severe, and as I don't play that many tapes, I more or less forgot about the tape speed problem. Then the car itself developed a peculiar fault.

Normally, once the engine had warmed up, the temperature gauge would sit at about half-scale and never move from there. But suddenly it started indicating an abnormally high temperature — although only when the car was moving. Once the car was stationary again, after about 20 seconds the reading would return to normal.

In the abnormal state the reading would climb and fall at a fairly sedate rate, so I didn't think it was likely to be some sort of intermittent open or short circuit.

Older cars often used a simple mechanical voltage regulator for the temperature and fuel gauges (maybe they still do!). This was just a bimetallic strip with a heater element wrapped around it, functioning rather like an indicator flasher unit.

When it was cold, current would flow through the heater element, which would

eventually cause the bi-metallic strip to bend and thus break the circuit. It would then cool down and straighten out again until the contact was remade and so on. The effective function was to maintain the bimetallic strip at a constant average temperature. The higher the battery voltage, the less time it needed to spend in the 'on' state to maintain the same temperature. This switched voltage thus provided an essentially stabilized power supply for the hot wire ammeters in the fuel and temperature gauges.

A common fault in early model Falcons was that the heater wire would go open-circuit, eliminating the regulating function and so making the gauges read maximum all the time. I seemed to remember the term 'five volt regulator' being mentioned somewhere, so I tried replacing the mechanical unit with a 7805 IC. The fuel gauge then worked perfectly, so I knew that the voltage was correct. Unfortunately it had no effect whatever on the strange behaviour of the temperature gauge.

Localised heating?

The problem I faced was this: WAS it just a gauge malfunction, or was there some weird condition in the engine that was causing localised heating around the temperature sensor? Certainly I didn't imagine the whole engine could heat up and cool down that fast, and there was no sign that it was doing so. But I wanted to be certain.

Unfortunately the engine was one of the old 289 cubic inch (4500cc) V8s, which were not all that common; so nobody I knew had that much experience with them. I decided the best approach would be to remove the temperature sensor thermistor from the block and measure its resistance sitting in a pan of hot water at a known temperature, then compare its resistance when it was fitted back in the block, in the fault condition.

I can't remember what the actual resistance was, but as the water heated up, its resistance seemed to change smoothly enough and no amount of tapping or banging could upset it. Then I fitted it back in the car and went for a drive, with my digital multimeter connected between the sensor wire and earth.

The meter was one of the 'Sabtronics' (USA) kits that were advertised in EA in the late 1970's. (It's still going strong 17 years on, incidentally!) In these, the 'over-range' condition is indicated by blanking the digits. However, there is a problem with this sort of indication.

Switched to the 'Ohms' range, the meter will spend most of its time reading an open circuit (i.e., over-range), so the digits will be blanked. So that you will know the unit is switched on, the 'Ohms' reading is always preceded by a minus sign. This is important in light of what happened next.

I let the engine warm up for a while, until the ohms reading seemed to stabilise, then I drove off. With a sinking feeling I watched the display. As soon as I started moving the resistance began to fall. Down, down, faster and faster it fell, until it reached zero. Then, the minus sign disappeared and it began to climb again! What the...? A NEGATIVE resistance?

Suddenly the penny dropped.

I switched the meter to the 'volts' range. The engine block was about four volts NEGATIVE with respect to the chassis! When I stopped and let the engine idle for a while, it dropped back to about half a volt. I got out a jumper cable and connected it between the engine block and the chassis. The voltage

dropped to zero. I reconnected the temperature gauge and sure enough, after that it worked perfectly. I drove up to the local garage, bought a proper battery cable and made a permanent job of it.

So what was wrong? Well, in that car, the battery negative is connected to the engine block, as are the earth returns of the ignition and the voltage regulator/alternator circuitry. Thus all those systems (and the starter motor) will have a nice solid connection to the battery negative, and if you measure the battery voltage directly on the battery terminals, (as the dash-mounted meter did!) it will be correct.

Unfortunately, everything else in the car depends on the chassis for the negative return. To accommodate this, there's supposed to be an earthing strap from the chassis to the engine block — but obviously at some time in the car's life, this had been removed and not replaced.

Any electrical connection between the battery negative and the chassis was thus entirely accidental! When the car was stationary, the block would settle down and make a satisfactory connection; but as soon as I drove off, the contact would deteriorate.

The 5V regulator would still produce five volts between the gauge positives and chassis, so the petrol gauge would work OK, because the tank sensor is also connected to the chassis. However, the temperature sensor is earthed onto the engine block, so the four volts at that point would be added to the five volts from the regulator, giving the 'funny' readings!

Other benefits

Needless to say, once this fault was corrected the cassette player magically lost its wow and flutter. But there was more!

The turn indicator flasher unit now responded with a brisk businesslike 'CLICK-CLICK! CLICK-CLICK!', instead of the weary 'click...clunk, click...clunk' that I was used to. Also the horn now produced a mighty roar instead of its previous strangled bleat, and the headlights were noticeably brighter.

It also gave me an explanation as to why my radiator had rotted away, after only a few years! The chassis-earthed radiator would

be positive with respect to the engine's water jacket, attracting corrosive negative ions...

And my friend's problem? Well, he'd bought a rather nifty little gadget from one of those 'auto bargain-barn' places — a suppressed-zero voltmeter that plugged into the cigarette lighter socket. A great idea, I would have thought. Except that it would read the appropriate '13.8V' when the car was idling, but (you guessed it) the voltage would drop alarmingly whenever he drove off. Yet — the car ALWAYS started first time every time...

A proper battery strap fixed his problem, much sooner than it did mine!

Well, isn't that something? How many readers are right now dashing out to check if their car's battery strap is correctly positioned? I know I did!

Actually I have just such a temperature gauge problem as Keith described. But unfortunately, my trouble is of a different persuasion, since both volts and ohms read zero between block and chassis. I guess I'll have to seek *my* solution elsewhere.

This story had me really baffled, until Keith revealed the answer towards the end. However, one comment earlier in the story should have prompted the correct train of thought — he wrote 'In the abnormal state, the temperature would climb and fall at a fairly sedate rate.'

This description is a perfect slow motion allegory of 'motor boating', a common enough problem in radios and amplifiers when power supply (read 'earth return') impedances are upset.

All round, this was quite an interesting story. I imagine quite a number of technicians have chased wow problems in car cassette players, only to find later that it was a poor battery connection that was the real culprit. So although this was an auto electrics story, it carries a message for those technicians who dabble in car sound, and any others who might be confronted by a poor earth return situation.

Incidentally, and regarding the unusual coverage of the original radio/cassette, AM and shortwave, I seem to recall reading in a Clarion (brand) sales manual that these models were intended for sale in remote areas of Africa, Asia and South America. In fact, in some of these places there are not even any broadcast-band AM stations, let alone FM ones.

So the inclusion of shortwave reception makes good sense. Some of these models may well have been sold in Australia 20 years ago, since at that time we had plenty of remote areas with no AM stations and as Keith said, no FM stations in the settled areas either!

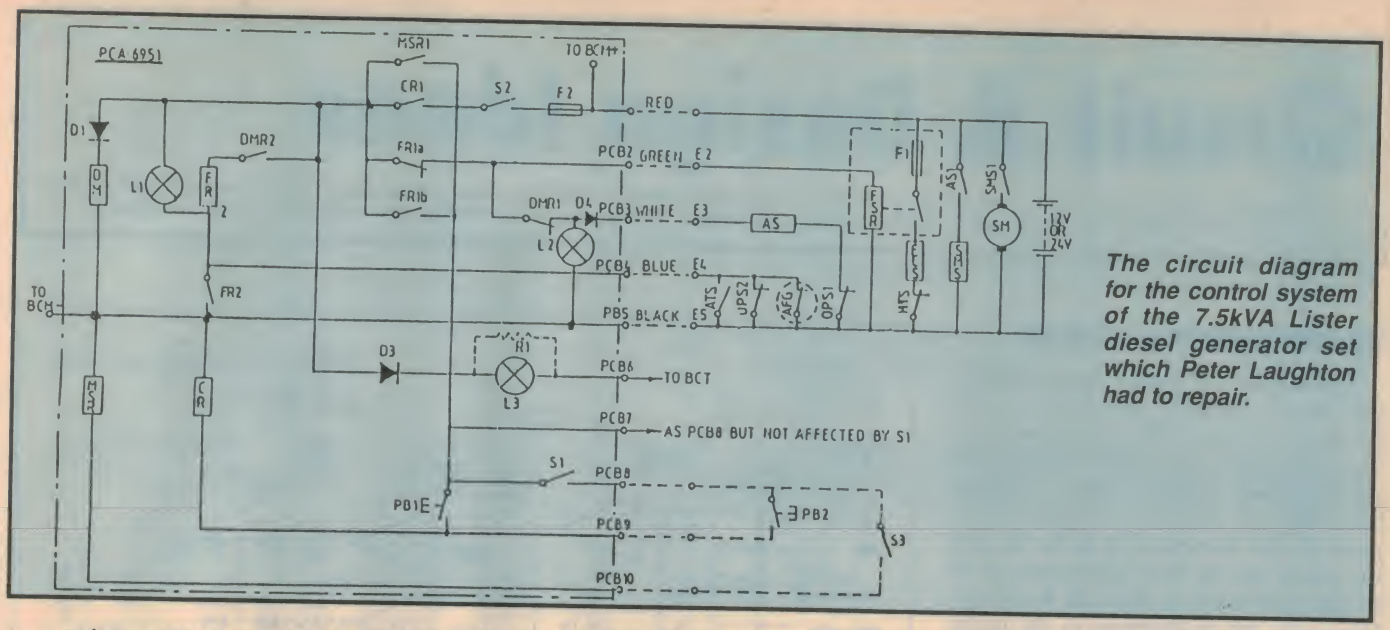
Thanks, Keith. Your story has more than the usual interest, since it provides food for thought from quite a number of different angles.

Genset troubles

Our next story is on a similar 'internal combustion' subject, and again demonstrates the trouble that our country cousins have to endure to get the power that we city dwellers get with the flick of a switch.

It comes from Peter Laughton, of Albion Park, NSW. We've heard from Peter before, with a long and involved story about home lighting systems. This tale concerns a similar installation, but with a different kind of fault. Here's his story:

It started out as an urgent call



The circuit diagram for the control system of the 7.5kVA Lister diesel generator set which Peter Laughton had to repair.

to repair a generator set, at a rather isolated property near here. It was a couple of days later before I came face to face with a 7.5kVA single phase, 50Hz twin-cylinder Lister diesel alternator set that could not be started, either remotely or locally.

The owner had jury-rigged several wires to the starter motor and also the fuel control solenoid, to enable him to use the system. This had effectively bypassed all the engine protection circuitry such as low oil level, oil pressure, cooling fan blocked etc. When I opened the control box I found, as well as the usual contingent of spiders and other crawly things, a large control board mounted via lugs to the switches and lights on the front panel.

While waiting for me to arrive, the owner had obtained the circuit diagram. As can be seen, for what it does it's rather complicated. The first problem was that the main 12 volt fuse was open, and it looked like a violent self destruction with blackened glass inside the tube.

A new fuse was fitted and this held OK. Now pressing the local start button (PB1) brought a healthy clunk from the relay CR, but still no start. There was no output to terminal PCB3, on the board. The delay module relay was picking up, as was the timer for overriding the protection upon startup.

With a lot of difficulty, the PCB was removed from the control box and connected to a separate variable low voltage power supply I had brought with me.

The relay CR turned out to be a latching type that had two sets of contacts, which changed state according to a pulse from pushbutton PB1. A quick check with the meter showed that the contacts weren't making properly, and a visual inspection through a rather dirty and faded plastic case showed some burning of the faces. Luckily, it was a double pole relay and the second set of contacts weren't used. I swapped the wires from the original contacts to the unused ones, plugged the board in, and tried a local start.

The starter now turned over, but still the engine didn't fire — the fuel solenoid wasn't picking up. (I had removed all the 'extra' wiring that the owner had fitted). Tracing the wiring to the terminal strip showed a low and varying voltage at terminal E2. I suspected a dry joint, but not anything like what I really found.

It turned out to be the actual push-on lug. It was a solder type, and although the wire was tinned and crimped into the lug, there was absolutely no trace of solder! In fact, closer inspection showed that none of the lugs had ever been

Continued on page 73

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Oil temperature indicator

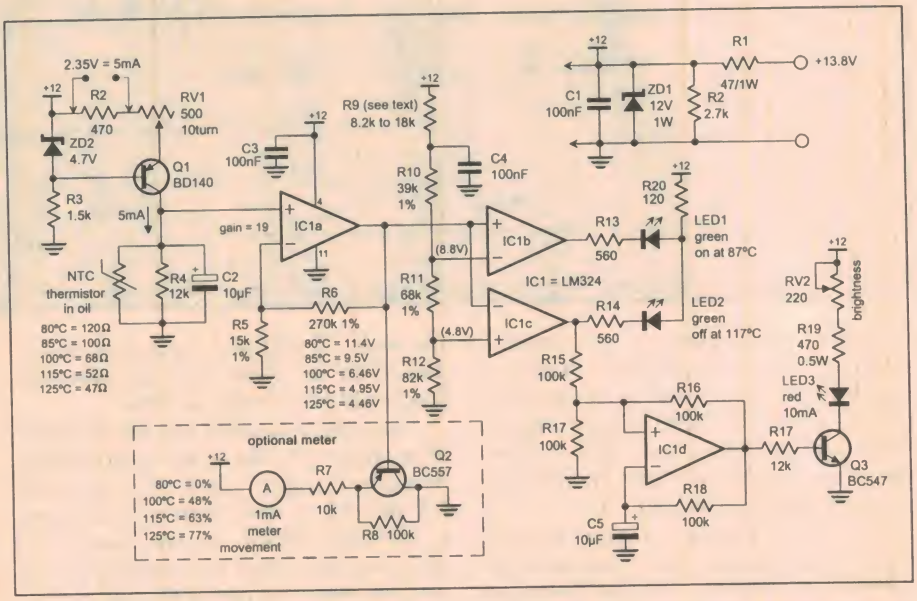
This circuit is basically a thermometer that uses a negative temperature coefficient thermistor. The thermistor used in the circuit is a VDO Instruments probe and comes with enough hardware to install it in place of a dipstick. The thermistor is in the tip, and the probe can be bent sufficiently to fit inside transmission dipstick housings. Obviously the connections to the probe need to be disconnected before using the probe as a dipstick.

The circuit gives a visual warning that the oil temperature in a transmission or sump is exceeding a certain value. This is usually a better indication of engine temperature than that given by the water temperature gauge.

The thermistor is supplied with a constant current of 5mA, developed by Q1 in conjunction with ZD2, R3, R2 and RV1. Because the base of Q1 is held at a constant voltage by ZD2, the emitter voltage is also constant, though higher by 0.6V. This voltage is across R2 and RV1, and RV1 is set to give the required 5mA, as indicated by a voltage of 2.35V across R2.

The NTC thermistor (placed in the oil being monitored) reduces its resistance with an increase in oil temperature. The resulting voltage across the thermistor is applied to IC1a, a non-inverting amplifier with a gain of 19. The output voltage of IC1a is then fed to the rest of the circuit to drive a meter (optional), or operate various LEDs.

IC1b and IC1c are comparators that sense the output voltage from IC1a. The trigger voltage for each comparator is set by the potential divider comprising R9 to R12. If you are using this circuit with a high-performance engine and high-temperature engine oils, increase the value of R9 to 18k. Otherwise, select a value for R9 to suit. For the thermistor shown, a value of 8.2k for R9 will cause the output of IC1c to go high for an oil temperature of 117°C. This extinguishes LED2 and enables the oscillator around IC1d, in turn operating Q3 which flashes LED3, giving a warning that the oil temperature is exceeding this level.



Increasing the value of R9 increases the temperature level at which comparator IC1c responds. As a general rule, at an oil temperature of 130° you have just enough time to get clear of traffic and park. An oil temperature of 80°C causes acid build-up to start boiling off.

The prototype was built on strip board and housed in a small jiffy box fixed to the dashboard with double-sided tape. A variation might include using two thermistors. By selecting either one with a switch, the circuit can monitor both engine and transmission temperature.

To calibrate the circuit, use a 100 ohm 0.5W resistor in place of the thermistor and adjust RV1 (a 10-turn pot) to give 2.35V across R2 (or 5mA of current in R2. Have the engine running to give a supply voltage of at least 13V. As a double check, turn the engine off, recheck the 2.35V across R2, then check that the output of IC1a is 6.46V, +/-2%. To confirm that the oscillator starts at an oil temperature of 125°, substitute a 47 ohm resistor for the thermistor. The output voltage of IC1a should be 4.46, +/-2%.

Peter Lucock,
Wynnum West, Qld. **$40**

EVER THOUGHT OF WRITING FOR EA?

Have you developed the circuit of the century, or a really great design, and would like to tell others about it? Have you written the best article ever on electronics theory or practice? Either way, you probably can't wait to see your work published as widely as possible.

Get your achievements to the largest number of your colleagues and fellow enthusiasts, and make some money at the same time, by sending your article to the Managing Editor of Electronics Australia, PO Box 199, Alexandria 2015.

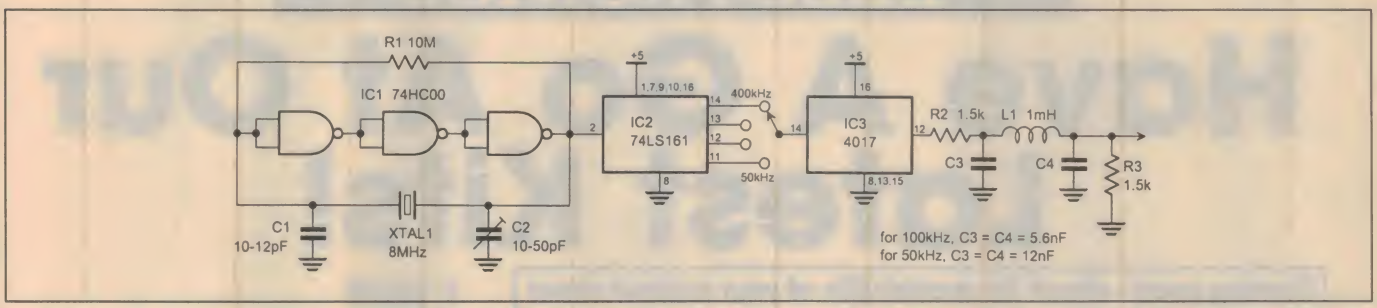
If you're not sure just how to write your article, ring our office on (02) 353 0620 and ask for a copy of our writer's guide notes.

Stable 100kHz source

I needed a very stable sinewave source for alignment of a multi-section crystal filter, which forms the heart of a commercial wave analyser. The source needed to be a stable 100kHz, +/-1Hz sinewave, variable by +/-5Hz.

An 8MHz crystal oscillator is formed by XTAL1 and IC1. Frequency adjustment is provided by variable capacitor C2. IC2 is a binary divider and IC3 is a decade divider. The network consisting of L1, C3, C4, R2 and R3 filters out anything above the second harmonic, giving a relatively pure 100kHz sinewave with excellent stability and variable frequency. By selecting different outputs from IC2 you can also get 50kHz, 200kHz and 400kHz outputs. However the values of C3 and C4 need to be changed to suit. Note that 4000 series CMOS ICs running at 5V have a maximum frequency of around 3MHz, so they are only suitable as a divider in this circuit.

Braham Bloom,
Russell Lea, NSW. **$35**

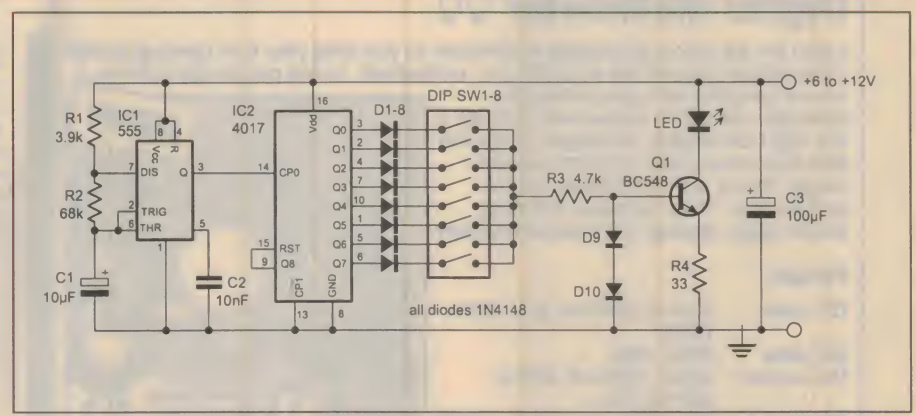


Flashing beacon

This circuit was designed after seeing an advertisement in an American magazine for a programmable beacon, with an output of about 700mCd provided by what appeared to be three LEDs.

It consists of a 555 timer running in astable mode at about 1Hz. This clocks a 4017 decade counter/divider with outputs 0 to 7 going high for one second each in a continuous loop, since the reset pin (15) is connected to output eight (pin 9).

Each output is connected to the base of Q1 via an isolating diode (D1 - D8) and a switch (DIP SW 1-8). Transistor Q1, R4, D8 and D9 form a constant current source for the LED. The current is 0.65 divided by the value of R4. Various flash patterns are possible, depending on the setting of the switches. For instance, one second on, then seven seconds off, or four seconds on and four seconds off.



I used a 3000mCd LED (available from Jaycar) operating at a current of 20mA. For best light output, use two or three LEDs in series, depending on the supply voltage.

Michael Sampson,
Tamworth, NSW. **$35**

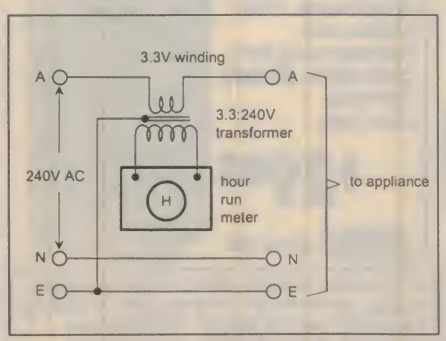
Energy monitor

Living with alternative energy (hydro and solar power) means it's often necessary to measure power consumption, to ensure that power inverters and generators are not overloaded. The measurement of energy consumption of individual appliances is also needed to calculate the amount of battery storage needed, as well as charging options etc.

The measurement of power consumption is straightforward using a moving iron ammeter (giving a true RMS response to the waveform of an inverter). However, the measurement of energy consumption involves time and isn't so easy.

This circuit is a very simple way of measuring energy consumption. A transformer is connected as a current transformer and supplies power to an hour run meter, a Warburton-Franki type obtained from Oatley Electronics for $15. This device is similar to the odometer of a car, in that it registers time on a number of wheels, to 0.01 of an hour. It operates only while power is applied, so the length of time an appliance consumes energy over a given period is recorded.

I used a transformer designed for a Scope soldering iron. However, the secondary voltage rating can be between three and 12 volts, as this rating only affects the lowest power the hour meter will respond to. The current rating of this winding should equal or exceed the full load current being measured. A refrigerator draws around 300 watts or 1.2A at 240 volts, so the winding must be able to carry that current.



Be careful if running the transformer without a load connected to the 240 volt winding, as a high voltage can be developed (more than 1kV in some cases). If using a multi-tap transformer, such as from an old radio or TV, terminate the unused windings with a suitably rated load resistor. By using this device you can check the energy ratings of appliances and compare it to the published rating. The prototype responded to a minimum power of 30 watts or so.

Peter Laughton,
Albion Park, NSW. **$30**

DICK SMITH ELECTRONICS

Have A Go At Our Latest Kits!

Coming soon - check for availability at your nearest store!

Digital Multimeter

Learn the ins and outs of digital multimeters as you build your own low-cost model! An essential piece of test equipment for enthusiasts, trades people and schools, it comes complete with comprehensive assembly instruction manual and features a 3.5 digit LCD display, 19-ranges, diode and transistor check, plus a 10 amp current range. The kit comes complete with all components, PCB, hardware (including plastic case), display, test leads and battery.

Ranges:

DC Volts:	200mV, 2000mV, 20V, 200V, 1000V
AC Volts:	200V, 750V
DC Current:	200uA, 2000uA, 20mA, 200mA, 10A
Resistance:	200, 2000, 20K, 200K, 2000K

Cat K-1044

SILICON CHIP June '95

$29.95

1 Watt Trainer Amplifier

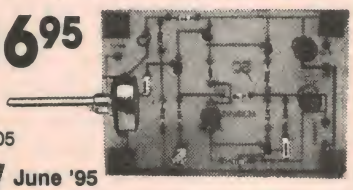
As the circuit diagram is printed on the circuit board, you'll find this kit very easy to assemble! Plus, it provides an easy-to-follow guide to how the circuit works! A 1-watt power amplifier, it can be used with your personal stereo, your personal CD player, or with your computer's CD-ROM. It uses low-cost components and is supplied in shortform with all components and silk-screened (colour-coded) PCB.

Specifications:

NEW!

Supply:	12 Volts
Output:	1.13W into 8 ohm
Sensitivity:	150mV for 1W (output into 8R)

$16.95



Cat K-5605

SILICON CHIP June '95

DISCOVERY SERIES

Parallel Port Interface

Into computers? With this kit your computer can sense data, process it, and use the results to control relays, solenoids, motors etc! The kit operates via a 9V battery or DC supply, can monitor 10 analogue voltages, drive 8 digital outputs, and generate 2 variable voltages. Designed to fit the Dick Smith Electronics zippy box (H-2851), the kit includes sample programs that can be manipulated to suit your needs, PCB, components and 25-pin 'D' type socket for connection to parallel port.

NEW!

Cat K-2805

EA June '95

$42.50

Transistor Tester

NEW!

An easy-to-build tester at a great low price! It simply plugs into a digital multimeter and produces an accurate measurement of transistor beta to values up to 50,000 and more. You can rely on it to test small signal, power and Darlington transistors and even Mosfets! It's battery-powered and comes complete with all components, PCB, plastic case, hardware and front panel label. (Battery Optional)

Cat K-7202

$29.95

SILICON CHIP June '95

Solarex 5 Watt Solar Panel

Ideal for electric fences, infrared sensors, maintaining the charge on marine and vehicle batteries, powering DC voltage devices and more.

Cat O-1005

LIMITED STOCK!

$99.95

Size:	306 x 346 x 21mm
Peak Watts:	5 watts
Current @ Norm. Voltage:	0.33A
Volts (open circuit):	23V
Amps Hrs/week:	13.86
Watt Hrs/week:	194.04

5-year limited warranty

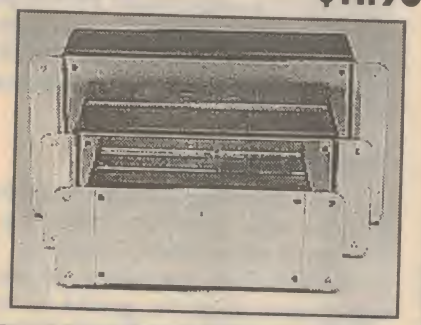
Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

See Us For A Huge Range Of Electronics!

Easy-Mount Boxes

Perfect for automotive applications, the bases of these project boxes have flanges that allow easy fastening to flat surfaces. With ABS plastic casing and aluminium base.

Length	Height	Depth	
100 Cat H-2890	x40	x50mm	$8.95
125 Cat H-2892	x40	x60mm	$9.95
145 Cat H-2894	x50	x85mm	$11.95



WTCPS Quality Solder Station

Its non-burning silicon rubber power cable and long-life, iron-plated tip make this Weller soldering station very reliable. It also has 48 watts capacity, low voltage internal transformer, lightweight soldering pencil and special "closed-loop" temperature control. Complete with stand and cleaning sponge.

Cat T-3000

$179

BONUS SIDE CUTTERS!

Bonus Side Cutters (T-2999) ***valued at $29.95.***

Weller

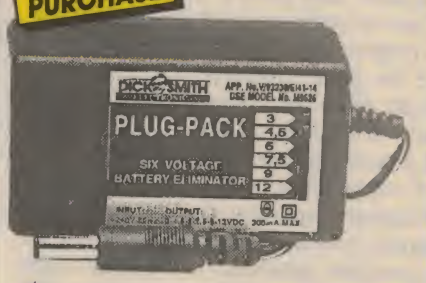
3-4.5-6-7.5-9-12VDC @200mA (300mA max) Supply

With six selectable voltages, this is an extremely versatile supply for around the home and workshop. Includes selectable polarity and 2.1mm female power connector (centre positive).

Cat M-7485

$9.95

SCOOP PURCHASE



Professional Quality Security System!

The Complete Home Security Pack

Professional quality home security in one take-home pack! It comes with everything you need to protect your home and belongings including easy to-read instructions that make installation a breeze!

- Professional 4-sector controller
- Two magnetic reed switches
- High pitched internal siren
- Flashing strobe
- Battery & mains power plug pack

Cat L-5150

- Two passive infrared detectors
- Emergency button
- External horn speaker & cover
- 100 metres of cable
- Deterrent stickers and instructions

NOW ONLY $499

Was $599 in 1994/95 Catalogue

Find out what's new and what's hot in our monthly publication 'Benchmark' - it's packed with new releases, super savings and handy advice! Pick up a copy from your nearest store today!

DICK SMITH ELECTRONICS

This magazine is now on sale at all of our New Zealand stores!

PHONE, FAX & MAILORDER SERVICE

AUSTRALIA: Outside Sydney: FREE Call (1800) 22 6610
Sydney and Enquiries - (02) 888 2105
Fax: (02) 805 1986 or write to
Dick Smith Electronics, Mail Orders, Reply Paid 160
PO Box 321 NORTH RYDE NSW 2113
NEW ZEALAND: Phone: (09) 480 8049 or (09) 480 3331
Fax: (0800) 800 290 or write to
Dick Smith Electronics, Mail Orders Division, Private Bag 102-903
North Shore Mail Centre, Auckland
All major Credit Cards accepted. Overnight Courier Available.

NSW • Albury **21 8399** • Bankstown Square **707 4888** • Blacktown **671 7722** • Bondi **387 1444** • Brookvale **905 0441** • Burwood **744 7299** • Campbelltown **27 2199** • Chatswood **411 1955** • Chullora **642 8922** • Gore Hill **439 5311** • Gosford **25 0235** • Hornsby **477 6633** • Hurstville **580 8622** • Kotara **56 2092** • Liverpool **600 9888** • Maitland **33 7866** • Mid City Centre **221 0000** • Miranda **525 2722** • Newcastle **61 1896** • North Ryde **937 3355** • North Sydney (Greenwood Plaza) **964 9467** • Orange **618 400** • Parramatta **689 2188** • Penrith **(047) 32 3400** • Railway Square **211 3777** • Sydney City **267 9111** • Tamworth **66 1711** • Wollongong **28 3800 ACT** • Belconnen **(06) 253 1785** • Fyshwick **280 4944 VIC** • Ballarat **31 5433** • Bendigo **43 0388** • Box Hill **890 0699** • Coburg **383 4455** • Dandenong **794 9377** • East Brighton **592 2366** • Essendon **379 7444** • Frankston **783 9144** • Geelong **232 711** • Highpoint **6300** • Melbourne City 399 Elizabeth St **326 6088** & 246 Bourke St **639 0396** • Richmond **428 1614** • Ringwood **879 5338** • Springvale **547 0522 QLD** • Alderley **356 3733** • Booval **282 6200** • Brisbane City **229 9377** • Buranda **391 6233** • Cairns **311 515** • Capalaba **245 2870** • Chermside **359 6255** • Indooroopilly **878 4944** • Maroochydore **791 800** • Mermaid Beach **785 600** • Rockhampton **27 9644** • Southport **32 9033** • Toowoomba **38 4300** • Townsville **72 5722** • Underwood **341 0844 SA** • Adelaide City **232 1200** • Elizabeth **255 6099** • Enfield **260 6088**• St Marys **277 8977** • Westlakes **235 1244 WA** • Balcatta **240 1911** • Cannington **451 8666** • Fremantle **335 9733** • Perth City **481 3261** • Midland **250 1460** • Northbridge **328 6944 TAS** • Glenorchy **732 176** • Hobart **31 0800** • Launceston **344 555 NT** • Darwin **811 977** * **STORES UNDERLINED ARE OPEN SUNDAYS. STORES ACROSS AUSTRALIA AND NEW ZEALAND**

DSE 'Discovery Series' Construction Project:

PARALLEL PORT INTERFACE

Latest release in the new Discovery Series of learning kits from Dick Smith Electronics is this low cost interface, which allows a personal computer to monitor and control a wide variety of equipment via its parallel printer port. It provides two analog outputs, eight digital outputs and 10 analog inputs — enough to more than satisfy most requirements. The complete kit is available from DSE's stores as Cat. No. K-2805, priced at $42.50.

If you are a creative person with a computer, then there's sure to be some project at home or work that could use this project. It acts as a 'real world' interface for your computer, allowing it to directly sense data, process it and use the results to directly control — rather than just processing data fed in manually.

In combination with readily available transducers (sensors) the computer can monitor physical parameters such as temperature, pressure, movement, light intensity, etc, process the information and then control physical things using relays, solenoids, motors and so on.

The interface works via a standard Centronics (parallel) printer port and, because of its low power consumption, can be operated from a 9V battery (not included in the DSE kit) or any DC supply in the range 7.5-25V. It can monitor 10 analog voltages, drive eight digital outputs and generate two variable analog voltages. It can also read its own power supply voltage, to make possible 'low battery' warnings, and the power supply can even be switched on and off by the computer.

Sample programs are provided which allow you to control the interface immediately. You can expand the programs later to suit your own needs.

Connection to the interface is made easy by PCB mounted plugs and sockets, which are provided in the DSE kit. A 25 pin male 'D' to 25 pin male 'D' connecting cable, preferably a shielded type, is required for connection to the computer printer port. The kit PCB is designed to fit in a Dick Smith Electronics 'Zippy' box Cat. No. H-2851. The printer cable and box are not provided with the kit.

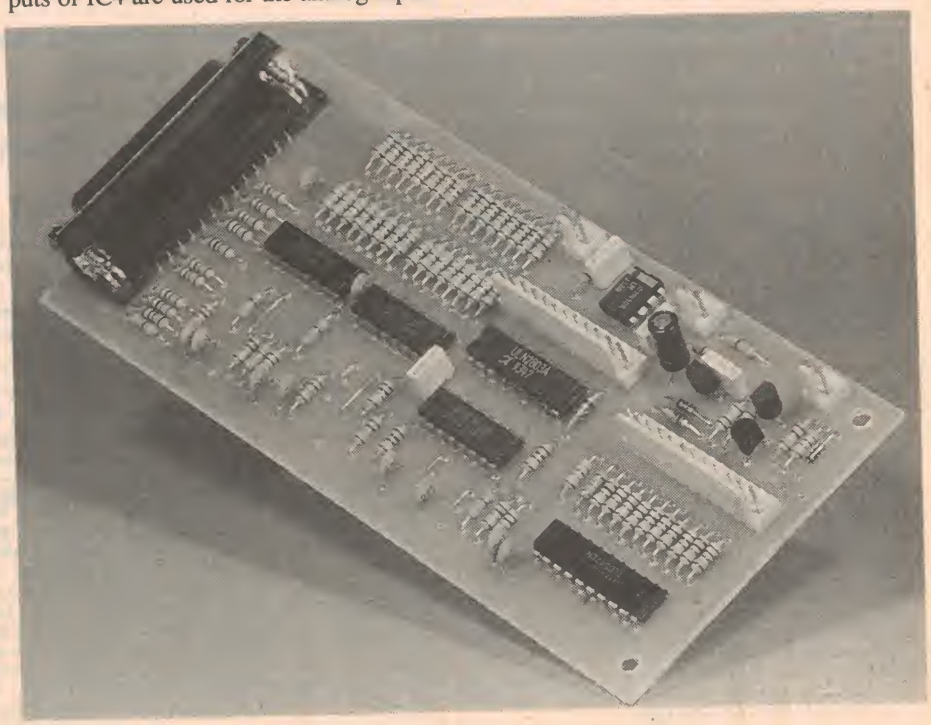
The interface circuit can be divided into a number of functional blocks. There is a 24-bit shift register/latch, consisting of IC's 1-3, which receives three eight-but bytes of data from the computer and holds it for controlling the interface outputs.

Two of these bytes, stored in IC1 and IC2, are used to drive a pair of digital to analog converters (DAC's) which convert this data into analog voltages at analog output terminals 0 (SK3) and 1 (SK2) respectively. The third output data byte, stored in IC3, is fed to buffer IC5 which allows each bit to control one of eight high current digital outputs available at connector SK4.

The analog input circuitry is based around IC4. This is an analog-to-digital converter (ADC) with 12 addressible inputs (A0 - A11), and serial interfacing on the digital side.

The computer is therefore able to instruct the ADC chip (via pin 17) regarding which of the analog inputs is to be selected, after which the ADC performs a conversion and signals the computer that the digital data is ready, via the EOC output. The computer can then retrieve the data serially from pin 16.

Note that 10 of the external analog inputs of IC4 are used for the analog inputs of the interface, while the final external input (A10) is used to allow the computer to monitor the interface's own battery voltage via resistive divider R65/R66. The twelfth input is connected internally, as described later.



The printer port

Before describing the functional blocks in more detail, it helps to know how the Centronics printer port is controlled. The port has 25 lines, some of which are for signals and others for ground or signal return paths. The signal lines are either read-only (input to the computer) or write-only (output from the computer) and use 5V (CMOS or TTL) logic.

In the computer, three addresses in I/O space are required to completely access the printer port. The first address is called the *base address* which is usually 378 (hex) for printer port 1 (LPT1) or 278H for LPT2.

The second address is (base address

+ 1) and the third address is (base address + 2). At each of the three addresses there is an eight bit byte stored, with bit 0 being the least significant bit (LSB) and bit 7 the most significant (MSB).

Every signal line on the port, whether it is used for read/input or write/output, is allocated one particular bit at one of these three addresses, the logic state of the bit indicating the state of the wire (0 or +5V). A few of the lines use negative logic — i.e. logic 1 corresponds to 0V and logic 0 to +5V. Table 1 shows the significant bits at each of the three addresses, and the functions these are used for, both normally when the port is used to communicate with a printer and in when it is communicating with the interface described here.

As an example of how the interface is controlled from a program written in QBASIC, the following short command sequence is used to switch the power on and enable the output of IC1:

BASE0 = &H378
OUT BASE0, &H80
OUT BASE0 + 2, &H01

Here the first line defines the base address of the printer port, as 378H. The second line then sends 80H (binary value = 10000000) to base address 378H, which sets data bit 7 of the port and switches the interface's power on. The third line then sends 01H (binary value 00000001) to address 37AH (base+2), which sets bit 0 of this data byte. As you can see from Table 1 this causes Strobe line 1 to be taken to 0V, as this line uses negative logic. However this line is actually used to enable pin 13 of IC4, which is an active-low input — so the desired effect is achieved.

The printer port output data is stored in latches, so the commands do not have to be repeated to keep any wire in a particular state.

Input conditioning

The devices in the computer that drive the printer port outputs may be either TTL or CMOS IC's. CMOS devices, such as this interface uses, cannot be directly driven (reliably) from TTL outputs because the logic 1 output voltage of a TTL device can sometimes be lower than the logic 1 input voltage required by CMOS devices.

In this project, this is avoided by adding 'pull-up' resistors R12-19 to the interface inputs, to ensure that the input voltages fall within the acceptable CMOS input range.

Another problem which has to be allowed for is that the cable connecting the printer port to the interface may pick up interference, especially if it is unshielded or running close to some strong electrical interference. The sort of noise that is likely to cause problems are short duration voltage spikes from arcing electrical contacts of equipment connected to the mains.

To suppress these spikes, series resistors R2-11 and shunt capacitors C2-11 have been added. An adverse effect of this sort of suppression is that it slows down the rate at which the wanted signals can change, by about 200ns. This effect can be ignored when using BASIC programs, and in any case it can be compensated for by providing suitable program delays.

Table 1
Printer Port Wire Allocations

Address	Bit	Wire	Direction	Kit Function	Printer Function
base	0	2	write	IC1 serial data input	Data bit 0
base	1	3	write	IC1 - 4 Clock	Data bit 1
base	2	4	write	Load IC1 latch	Data bit 2
base	3	5	write	Load IC2 latch	Data bit 3
base	4	6	write	Load IC3 latch	Data bit 4
base	5	7	write	IC4 chip select(-)	Data bit 5
base	6	8	write	IC4 address input	Data bit 6
base	7	9	write	Power on	Data bit 7
base+1	3	15	read	not used	Fault(-)
base+1	4	13	read	IC4 data out	Select
base+1	5	12	read	not used	Paper empty
base+1	6	10	read	IC4 end of conversion	Ack.(-)
base+1	7(-)	11	read	busy	not used
base+2	0(-)	1	write	IC1 output enable(-)	Strobe(-)
base+2	1(-)	14	write	IC2 output enable(-)	Auto feed(-)
base+2	2	16	write	not used	Init.(-)
base+2	3(-)	17	write	IC3 output enable(-)	Select In.(-)
		18-25		0V	0V

NOTES:
1. Normal base addresses are; LPT1 = 378H, LPT2 = 278H
2. (-) next to the bit no. means if the bit is set to 0 then the wire is at +5V.
3. (-) next to the function means the function is activated by 0V.

Interface details

For the control of so many inputs and outputs, the interface designer chose to use serial rather than parallel data transfer between the computer and the interface board. Serial data transfer requires less wiring, less hardware and consequently less PCB space.

Data from the printer port to control the 10 interface outputs (analog outputs 0/1, and digital outputs 0-7) is initially loaded via pin 2 of DB25 connector SK6 into the series-connected shift registers IC1-3, via pin 14 of IC1. The eight-bit shift registers in IC's 1-3 have their serial inputs at pin 14 and serial outputs at pin 9 (as well as an eight-bit parallel output), which allows the three to be connected in series as a single 24-bit serial in/parallel out shift register. Data is moved through the shift registers one bit at a time by clock pulses applied simultaneously to pin 11 of all three devices.

The clock inputs are normally held at 0V, and generating a clock pulse involves applying logic 1 to pin three of the printer port, and then removing it with the next command. Delays involved in the processor carrying out these instructions normally ensure an adequate resulting width of the clock pulse, or of similarly generated signals.

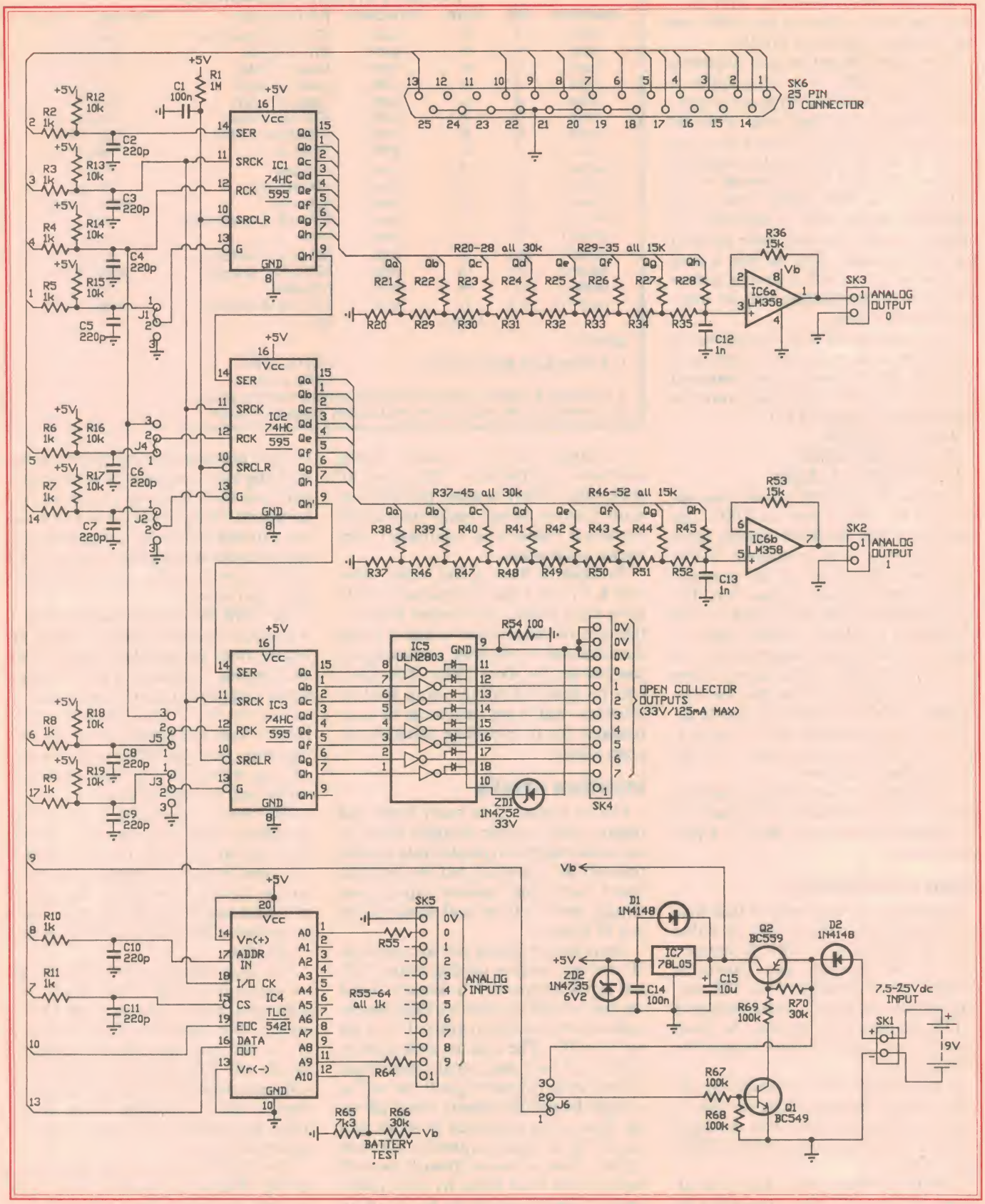
The 74HC595 devices used for IC's 1-3 contain eight-bit latches. These are loaded from the parallel outputs of the shift registers whenever a positive-going signal is applied to pin 12. Latches are required in this circuit because if the DAC's were fed directly from the shift registers, then the DAC output would change erratically as new data was shifted into the shift registers.

The three latches can be loaded individually using separate pulses on port lines 4, 5 and 6 (SK6), if links J4 and J5 are wired in the 1 - 2 position (as shown on the circuit). Alternatively they can all be loaded together from a pulse on line 4 of the port, if these links are fitted in the 2 - 3 position.

The latch outputs of the 74HC595 are tri-state and can be switched off, i.e.. made open circuit, whenever pin 13 is at logic 1. This causes the DAC outputs to go to 0V and the digital outputs to switch off. This facility is available for software control if links J1, J2 and J3 are fitted in the 1-2 position, or can be disabled by inserted these links in the 2-3 positions instead.

The 74HC595 devices also have a reset facility. Whenever pin 10 is at logic 0 the registers are reset to contain all 0's, while when this pin is at logic 1 they are free to accept data.

'DISCOVERY' SERIES PARALLEL PORT INTERFACE



Although it may look a little complex from the schematic, the interface hardware is relatively straightforward and involves only a small number of ICs. Chips IC1 to IC4 perform the serial input and output functions.

In this circuit the reset inputs have all been connected in such a way that when the power is applied to the circuit, reset occurs until C1 charges via R1. In other words, the registers are reset during power-up, but then allowed to accept data from the PC port.

D-to-A converters

The eight-bit digital to analog conversion is carried out by resistor networks R20-35 and R37-52, which are known as R-2R 'ladder' networks because only two values of resistor are used, having values in the ratio 1:2.

The analog output voltage (Vout) is related to the digital output (N) by the following formula (Vcc in these formula is the +5V supply rail voltage, not the LM358 supply voltage):

Vout = N * Vcc/256

where Vcc is the +5V supply rail voltage of IC1 and IC2, not the supply voltage of IC6. So in this case the output voltage is approximately equal to:

Vout = N * 20mV

In other words, the output voltage cannot be varied continuously, but in minimum increments of 20mV. These steps and any other 'glitches' which may occur at the output of the DAC network, are rounded off or filtered out by capacitors C12 and 13, and then buffered by unity gain amplifiers IC6a and IC6b before appearing at the output terminals. The final output voltages vary from 0V to +5V, in 20mV steps.

Before connecting a load to the analog outputs, it should be noted that the outputs should be used as current *sources* rather than as current *sinks*; i.e., they work best into a resistive load connected to ground. The reason for this is that the LM358 negative supply is at 0V, and the output voltage cannot reach 0V when sinking even small currents. Whereas because the positive supply is at least 1.5V above 5V, the outputs can reach 5V for output currents up to at least 20mA.

Another reason for making supply for IC6 greater than 5V is that the operating voltage range for the LM358 inputs is from 0V to (Vcc-1.5V). The output from the R-2R resistor network can reach +5V, and so the positive supply for IC6 has to be at least 6.5V.

Digital outputs

The eight output bits from IC3 are fed to eight separate buffer amplifiers, all contained within IC5, which is a ULN2803.

These buffers act as switches connected between the output and ground, each using a single stage Darlington transistor configuration with an open collector output. When the input is at +5V the switch is on, and when the input is 0V the switch is off.

To protect the output transistors, the outputs are all connected via separate diodes inside the IC to a common point which appears at pin 10. By connecting a zener diode between this point and the IC ground, the voltage at the outputs is prevented from exceeding the zener voltage (plus the diode forward voltage drop).

If a transient voltage higher than 33V appears on the output, as when switching relays or other inductive loads, the zener conducts and prevents the output voltage from exceeding approximately 33V. This method of protection does not significantly increase the release time of a relay connected to the output, as would occur with a diode across the relay coil. The voltage that the outputs of the ULN2803 can withstand without protection is 50V.

The total current flowing through the ground pin of IC5 can reach 4A if each output has 0.5A flowing into it. To prevent heavy currents from being directed through the thin ground tracks on the PCB, the return paths for the digital loads must be connected to the 0V terminals of the digital output socket SK4, which can then be connected externally to the (-) supply terminal of the interface power supply.

In the event that the ground connection to SK4 becomes disconnected, resistor R54 (100 ohms) prevents damage to the board by isolating the main circuit ground from the digital output ground. The input currents to IC5 also flow through this resistor, but it is small enough not to effect normal operation.

Interface specification

Analog outputs (2):	
Voltage range	0 - 5V unloaded
Resolution	8 bits (20mV/step)
Source current	20mA approx.
Sink current	5uA for 20mV (1 LSB) error at 0V out
Digital outputs (8):	
Output sink current	500mA maximum (open collector)
Output voltage	33V maximum
Output protection	33V clamp, all outputs to ground
Analog inputs (10):	
Voltage range	0 - 5V
Input resistance	typically >100M
Resolution	8 bits (20mV/step)
Input protection	+/-20mA abs. max input current +/-30mA abs. max total input current

Computer port requirements:
Centronics type parallel printer port; interface has a 25-pin female 'D' connector, with standard wiring. CMOS or TTL compatible

Power supply:	
Voltage range	+7.5V to +25V DC
Current drain	typically 8-10mA at 9V DC

A to D converter

The analog to digital conversion is done entirely by IC4, a TLC542. This device has 11 analog inputs, which are selected one at a time by a 4-bit serial address entered via pin 17. The analog input voltage is converted to an eight-bit number which is then available as serial data from pin 16.

One clock input simultaneously causes the address to be read in and the data to be generated ready for output. The TLC542 has an internal clock which controls the conversion process. The EOC (end of conversion) output generates a low to high transition at pin 19 whenever a conversion is completed.

To convert the analog input voltages to digital values, an external reference voltage is required. The reference voltage inputs are Vref(+) at pin 14 and Vref(-) at pin 13, which in this circuit are connected to Vcc and GND respectively. The relation between the digital output value (N), the reference voltages V- and V+ and the analog input voltage Vin is given by the following formula:

N = integer value of
[255*(Vin - V-)/(V+ - V-)]
= integer value of [51.0*Vin]
when V+ = +5V and V- = 0V

The accuracy of the conversion depends on the actual value of Vcc, which can be anywhere between 4.8V and 5.2V with the nominal 5V regulator used for IC7 (a 78L05). This is a scale error that can be easily removed by the computer program, to get an accuracy typically as good as one LSB (20mV) over the range 0 to +5V.

The analog inputs to the TLC542 are protected by internal clamping against voltages that go outside the range 0 to +5V. These clamps can withstand currents of up to +/-20mA individually, or a total input current for the whole IC of +/-30mA. The external 1k resistors in series with the inputs allows the terminal voltage to reach approximately +25V or -20V before damage occurs.

The interface has 10 inputs for external connections and two dedicated inputs. The eleventh input of IC4, pin 12, is connected via divider network R65/R66 to Vb, the input to the 5V regulator. The voltage divider is arranged so that when

Vb is 25.5V, the voltage at the junction of R65 and R66 is 5V, giving a digital reading of 255. The regulator IC7 requires an input of at least 7V to function properly, so if the digital value read for this input falls below 70, the program can be arranged to give a low voltage warning.

The twelfth input of IC4 is an internal connection to the mid-point between the analog reference voltages, and should always give a digital reading of 128 +/-2, irrespective of the reference voltages. Reading this input is thus an easy way to test a program.

The power supply

The interface can be operated from any filtered, reasonably stable DC supply with a voltage range between 7.5V and 25V. The supply is connected via series diode D2, which protects the circuit in the event that the supply polarity is reversed. It then passes through transistor switch Q2, which is controlled from the computer via transistor Q1 if J6 is linked between pins 1 and 2. Alternatively if J6 is linked between pins 2 and 3, the interface is switched permanently 'on'.

The output (collector) of Q2 is fed to IC7, a 78L05 voltage regulator, as well as to the supply pin of IC6. Capacitors C14 and C15 provide some filtering to optimise the stability of the 78L05. Diode D1 prevents the output of the 78L05 from becoming more positive than its input under fault conditions, and zener diode ZD2 prevents the +5V rail from being driven to a high voltage in the event that excess voltages are applied to other circuit terminals.

If an unregulated power supply is used, then for best conversion accuracy it is advisable to use a separate power supply for relays or heavy loads that are being controlled by the interface. For example, the interface can be operated from a 9V battery, and relays, solenoids etc., from a plugpack or 12V battery.

Construction

Assembly of the interface is fairly simple, with all of the components being mounted on a single printed circuit board (PCB) measuring 145 x 68mm. The DB25 connector SK6 which mates with the cable from the computer printer port is fitted at one end.

To place the various components, use as a guide the overlay diagram which shows how the components and wire links (jumpers J1-6) actually fit on the PCB. Read the label of the component, e.g. C1, from the overlay and then look up the description next to that label in the parts list. For example, C1 is an MKT type capacitor and it has the value 0.1uF (100nF); the actual part be marked either '100n' or '0.1'.

Some of the components used are actually a substitute for a wire link. They have the appearance of a 0.25W 5% carbon resistor, but have a nominal 0 ohm resistance, and on the overlay they are shown as a resistor with the label R0. These are used in place of permanent wire links, because they are easier to install than wire links and make the board look more tidy.

Begin construction by mounting the links and resistors R0-70. To find the resistor you want, a table has been provided which shows the colour code for each value.

The last band of the colour code gives the tolerance value and is the one that is farthest from the others. Resistors can be mounted in either direction, but it is good practice to mount them with their colour codes all in the same direction, for ease of reading the values.

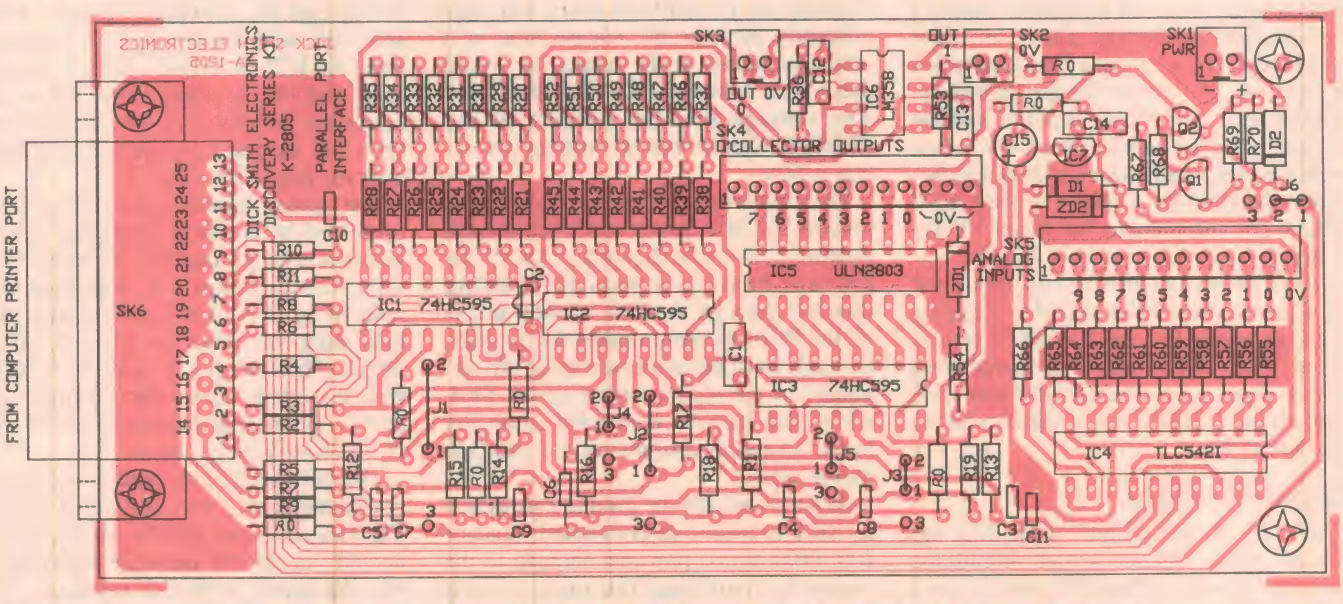
Next mount the diodes D1 and D2 and ZD1/2. These must be mounted in the correct direction only, with the stripe on the very end of the diode corresponding to the striped end on the overlay diagram.

Now mount the capacitors C1-15. One thing to note when identifying a capacitor is that the value can be marked on it in different ways; for example '103', '10n' and '.01' are all the same value and are shortened notations of 10000pF, 10nF and 0.01uF respectively.

Capacitors C1-14 are non-polarised types which can be mounted in either direction, but C15 is a polarised electrolytic which will have a negative (-) or (+) sign marked on it and must be mounted in the direction shown on the overlay.

Next mount the integrated circuits IC1-6. Note that IC's 1-4 are CMOS types, which are sensitive to static electricity. To prevent them from being damaged, note the following precautions:

- Do not remove them from their protective foam until you are ready to install them.
- Avoid touching the pins with your fingers.



Here is the PCB overlay diagram, showing the location and orientation of all parts used in the interface.

- Make sure that your soldering iron is properly earthed.
- Solder the power and earth pins of each IC to the board first.

Note that the IC's have a notch at one end, which goes at the end indicated on the overlay diagram.

Next mount the transistors Q1-4. Position them so that in each case the flat side is facing in the direction shown on the overlay. Do not press them down hard onto the board, as this spreads the leads and can damage the transistor's internal connections.

Now mount sockets SK1-6. The pins in the pin header type sockets SK1-5 can be pushed through their plastic casing if too much force is used on them, so before you solder them make sure that the pins are all level.

With the assembly of the board complete, carefully check all the soldering. Look especially for dry solder joints, and solder bridges which may be shorting tracks together.

Programming control

Finally, a bit more detail on the way the interface can be controlled from your PC program.

The data input to the shift registers which drive the DAC and digital outputs is pin 14 of IC1, which is fed from pin 2 of the printer port (SK6). Looking at Table 1, pin 2 is controlled by bit 0 of the 8-bit byte fed to the port's base address. So we have to send our data to the LSB of the base address, one bit at a time, and follow each bit with a clock pulse at bit 1 of the same address (SK6 pin 3).

For example, to set the voltage at analog output 1 (the second DAC, at SK2) to 1V, the following sequence has to be followed:

1. Convert the voltage to the equivalent digital value of (Vout/20mV) =51 (rounded to nearest integer value).
2. Work out the equivalent 8-bit binary value to be sent to the printer port; here it is 00110011.
3. Send the MSB of this binary value (here 0) to the port base address, by assembling the following data byte and writing it to the port I/O address:
bit 0 = 0 (value MSB)
bit 1 (clock input) = 0
bit 2-6 = 0
bit 7 (power on/off)
= 1 (to turn the power on)
4. Send the same byte as in (3) again, but this time with the clock bit (bit 1) set to 1.
5. Finally send the same byte yet again, but with the clock bit set back to 0, to finish the clock pulse.

PARTS LIST

Resistors

(All 1/4W, 1% unless otherwise stated)

R1	1M
R2-11,55-64	1k
R12-19	10k
R20-28,37-45,66,70	30k
R29-36,46-53	15k
R54	100 ohms
R65	7.3k
R67-69	100k
R0	(0 ohm carbon film 1/4W 5% construction)

Capacitors

C1,14	0.1uF (100nF) MKT
C2-11	220pF ceramic
C12,13	1nF (1000pF, 0.001uF) MKT
C15	10uF 25VW RB electrolytic

Semiconductors

D1,2	1N4148 small signal diode
ZD1	1N4752 33V/1W zener
ZD2	1N4735 6.2V/1W zener
Q1	BC549 NPN small signal transistor
Q2	BC559 PNP small signal transistor
IC1-3	74HC595 shift register
IC4	TLC542I serial ADC
IC5	ULN2803 octal Darlington driver
IC6	LM358N dual op-amp
IC7	78L05Z 5V regulator

Miscellaneous

SK1-3	Two-way SIL pin header and plug
SK4,5	12 way SIL pin header and plug
SK6	25 pin, PCB mount 'D' socket
PCB	147 x 71mm, coded ZA-1205;

216-type 9V battery snap; two 9mm long M3 bolts with washers and nuts.

6. Repeat steps 3-5 for all the remaining bits of the binary data byte worked out in step 2.
7. Since the above steps will have only sent out the data byte to IC1, another eight clock pulses are required in order to send it to IC2, for the second DAC. Do this by repeating steps 3-5 again, but with either a dummy data byte (all zeroes), or else with the data for DAC1.
8. Finally, load the latch of IC2 by sending the following byte to the base address:
bits 0-2 = 0
bit 3 (load IC2 latch) = 1
bits 4-6 = 0
bit 7 = 1
9. Send the same byte as in (8) again, but with the latch load bit (bit 3) set to 0.
10. Finally, enable the IC2 output gate by sending the following byte to (base address + 2):
bit 0 (IC1 output enable) = 0 (or 1 if DAC1 is to be enabled as well)
bit 1 (IC2 output enable) = 1
bit 2 (not used) = 0
bit 3 (IC3 output enable) = 0 (or 1 if digital outputs are to be enabled as well)
bit 4-7 (not used) = 0

The output of DAC2 should now be 1V, available at SK2.

The equivalent programming for analog to digital conversion will not be described, but the following information should allow you to work out the required steps yourself. As shown in Table 1, the control inputs to IC4 are via the printer port's base address, and its outputs are via (base address + 2).

The normal control sequence needed for analog to digital conversion is as follows:

1. Chip select (CS) of IC4 starts high, and is then brought low to enable the device. The MSB of the last conversion automatically appears on the output.
2. On the first four rising edges of the I/O clock (pin 18), the input address is shifted into IC4, with the MSB first. The negative edges of these clock pulses shift out the second, third, fourth and fifth most significant bits from the last conversion. Sampling of the analog input begins on the fourth falling edge of the I/O clock.
3. Three more I/O clock pulses are applied and the sixth, seventh and eighth bits of the last conversion are shifted out on the falling edges of these pulses.
4. The eighth and final I/O clock pulse is applied. On the falling edge of this pulse, the EOC output goes low and the sampling and conversion continue, for about 32us. The I/O clock input must remain low or the CS (pin 15) taken high, until the conversion is completed. The EOC output goes high to signal the end of the conversion process.
5. Steps 1-4 are repeated to read the result of the conversion.

Using this sequence as a guide, you should be able to work out the programming to achieve it. Remember that the input selection address for IC4 must be sent to it via pin 8 of SK6, corresponding to bit 6 of the printer port base address. As the serial clock line of IC4 is fed from pin 3 of SK6, you'll again need to follow a similar clocking sequence as for the output programming, with a 0-1-0 bit sequence fed to bit 1 of the printer port base address to produce each clock pulse. ❖

Resistor Colour Codes

Value	4 Band 1%	5 Band 1%
100	Brn Blk Brn	Brn Brn Blk Blk Brn
1k	Brn Blk Red	Brn Brn Blk Blk Brn Brn
7.3k	Vio Org Red	Brn Vio Org Blk Brn Brn
10k	Brn	Blk Org Brn Brn Blk
15k	Brn	Grn Org Brn Brn Grn
30k	Org Blk Org	Brn Org Blk Blk Red Brn
100k	Brn Blk Yel	Brn Brn Blk Blk Org Brn
1M	Brn Blk Grn Brn	Brn Blk Blk Yel Brn

Construction Project:

CFL & FLUORO LAMP INVERTER

Fluorescent lamp inverters are not new, but how about one that can drive compact fluoro 'energy saver' lamps? This project can supply a load up to 40W at 350V DC from a 12V battery, is highly efficient and connects directly to a compact fluorescent lamp. But there's even more, as you'll see...

by PETER PHILLIPS

Battery powered inverters that can drive a fluorescent lamp have featured before in *EA*, and these projects have always proved popular. However, we have never described one that can directly drive a compact fluorescent lamp (CFL), or 'energy saver' lamp as they are also called. These lamps have been available now for about five years, and were described at length by Jim Rowe in the September 1991 edition, in Forum. Further discussion on these lamps can also be found in Forum, November 1992.

The main features of a CFL compared to an incandescent lamp are *five* times the efficiency, and *eight* times the lifespan. This means a 15W CFL has the equivalent light output of a 75W incandescent lamp, and it lasts eight times longer. As well, a CFL has a better 'light colour' than a conventional fluoro, making them more suitable for domestic use.

Anyone who relies on battery power is always interested in electrical efficiency. For these people, the CFL has probably been seen as a desirable, if unreachable solution to an efficient 12V DC lighting system. In fact, those who have tried to power a CFL from a DC to 240V 50Hz inverter have often found the life of the CFL reduced to a mere few hours. This is particularly true if the inverter output is a square wave, as is often the case.

The answer is to drive the lamps from a DC supply, not AC. Of course that's not all there is to it, and we'll have more to say about the CFL later, but first a closer look at other aspects of this project.

The project

This project comes from Oatley Electronics, with much of the design done by Conrad Marder. The inverter is based on a switching IC, type SG3525, and has MOSFETs as the switching devices. A specially designed transformer and high speed diodes complete the main component lineup.

The inverter is extremely efficient, and virtually no heat is generated in the circuit when it's driving a 20W load. This means virtually all the input power is fed to the tube and converted to light output.

The normal output voltage of the inverter is around 350V DC and several CFLs can be connected to the one inverter, up to a total load of 40W or so. Each lamp can be switched on or off as required, so you could have a conventional lighting system based on CFLs running from the one inverter. We'll have more to say about this aspect later, but as we said in the introduction, there's more...

Any fluorescent lamp is more efficient than an incandescent lamp, and battery powered fluorescent lamps have been marketed for years. However as many people will be aware, the lifespan of the tube in these units is often quite short. The main reason is that the tube is not being driven correctly, because the tube filaments remain cold during operation. The inverter we're describing here cannot directly drive a fluorescent tube, as it has no inherent current limiting. A conventional ballast can't be used, as the output of the inverter is DC. However Oatley Electronics has been able to obtain two types of electronic ballasts that can be used with this inverter.

The first, shown in Fig.1, suits an 18 to 20W tube. The output of the inverter is connected to the input of the electronic ballast, which as shown in the photo, connects to the tube.

The second, shown in Fig.2 is a more elaborate electronic ballast that features a dimming control. This unit is for 32 to 36W tubes, and an external DC voltage or a 100k ohm variable resistor can be connected to the unit to vary the brightness of the tube. As before, this ballast connects to the output of the inverter.

The important point is that in both cases the tube is being operated in the correct way. That is, the filaments remain hot during operation and are used to start the tube. This means the life of the tube is not compromised by the usual cold start and cold operation provided by many portable fluorescent lamps.

Electronic ballast

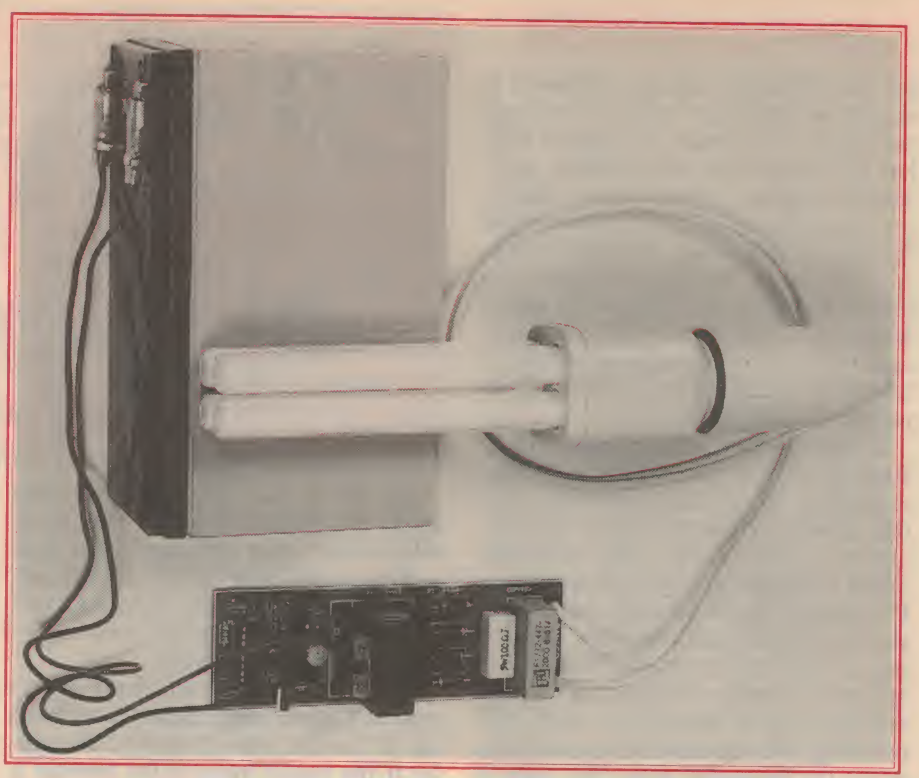
In an electronic ballast, the incoming 240V mains is applied directly to a mains-rated rectifier, usually comprising four 600V 1A diodes. The resulting DC from the rectifier is filtered with a 10 to 20uF 400V electrolytic capacitor, and is then applied to an inverter.

For this reason, an electronic ballast can operate from a 350V DC supply, of either polarity. In this case, two of the diodes in the bridge conduct continuously. In fact, the complete rectifier could be removed, but this is usually impractical and polarises the inputs.

Apart from giving a flicker free start, an electronic ballast offers a number of advantages over the conventional iron-cored ballast.

Perhaps the most important is the elimination of the strobing effect, due to the relatively high operating frequency of the inverter in the ballast. Fluorescent tubes operating at 50Hz are often traced as the reason for headaches and the like, so increasing the operating frequency solves these problems.

As well, there's no buzzing caused by loose laminations, the fluorescent tube has a longer life and the overall efficiency of the light is increased. So even if you are not interested in using the inverter with a CFL, there's plenty of reasons to use it with an electronic ballast and a conventional tube.



This project lets you operate a compact fluorescent lamp from a 12V battery. The overall high efficiency makes it ideal for boaties, campers and anyone relying on battery power.

The prices of each system are given at the end of the article, including a price for the inverter kit *with* a CFL. In fact, before describing the inverter, we need to explain a few things about CFLs.

About CFLs

It would be nice to be able to say that this inverter will work with all CFLs. However, this is not the case, as it appears there are at least three different types on the market.

While there's no reason to, most people assume that a CFL has an electronic circuit to achieve the high efficiency. In fact, the tube design is mainly responsible

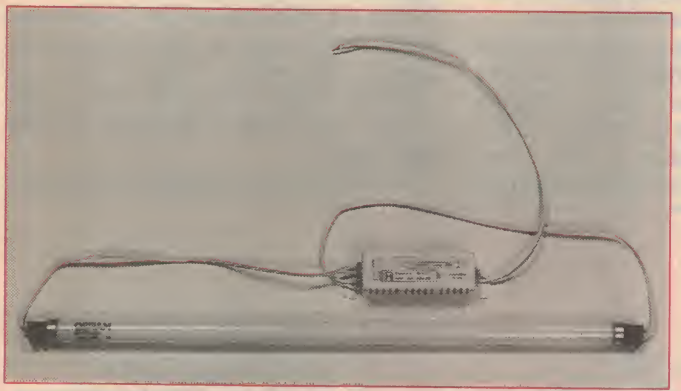


Fig.1 (above): This shot shows the 20W electronic ballast described in the article. The ballast connects directly to the output of the inverter and is shown here connected to an 18W 600mm fluorescent tube.

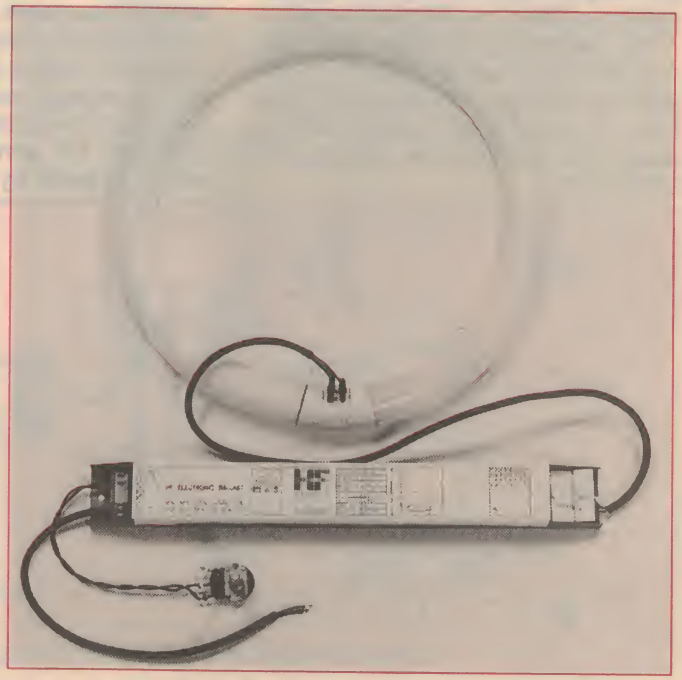


Fig.2 (right): The electronic ballast shown here is suitable for 32 to 36W tubes, and features a dimming control. It connects to the output of the inverter and gives flicker free start-up.

for the efficiency, and the electronics is simply an electronic ballast as already described. For instance, one type of CFL has an internal iron cored ballast and a starter integrated with the tube. That is, it's much the same as a conventional fluorescent light fitting. This type of CFL is quite heavy, and one version is the Philips SL series, where the actual tube is housed in a translucent dome. So, because it uses a conventional ballast, it cannot be operated from a DC supply as produced by our inverter.

The next type *is* all electronic, and at first glance seems identical to the electronic version that will work with this inverter. However, this type requires a 50Hz supply, and operates rather inefficiently when connected to a DC source. The block diagrams in Fig.3 show the difference between the two types. In (a), the incoming 240V AC is applied to a bridge rectifier with a filter capacitor of at least 10 to 20uF. The resulting DC supplies the inverter that drives the fluorescent tube. This type of CFL *will* work with the inverter described in this article.

The version that *doesn't* work with this inverter is shown in Fig.3(b). As before, the incoming mains supply connects to a bridge rectifier, but now the filter capacitor is less than a microfarad. A fifth diode (D1 in Fig.3) isolates the real filter capacitor from the bridge. With this circuit, mains current flows virtually all the time, unlike the previous circuit, where mains current flows for short intervals at the peak of each cycle. Also, the inverter operates from a DC-plus-100Hz unfiltered rectified AC supply.

The important point is that CFLs fitted with this circuit are not suitable for use with our inverter. While the tube will light, the current taken from the battery is nearly twice that when the correct type of CFL is used.

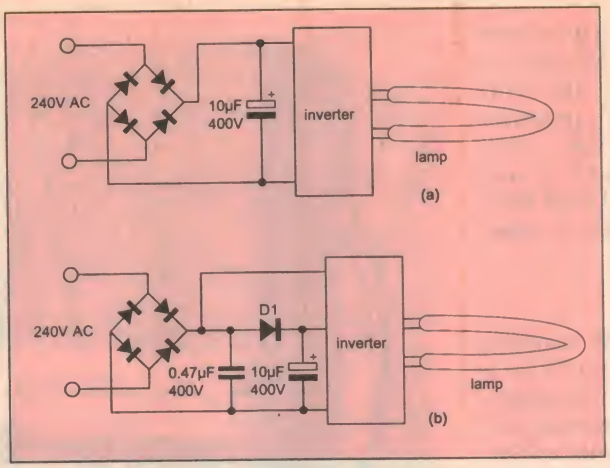


Fig.3: The basic internal circuit of a CFL that will work with the inverter is shown in (a). The version that will not is in (b). Notice in (b) that the 10uF filter capacitor is isolated from the mains by D1.

As far as we can make out, this type of circuit is used in those CFLs that come packaged as a base and separate plug-in tube. They are often cheaper than the type that will work with this inverter, and we've seen at least two brands.

The easiest way to tell if the correct type of CFL is being used is to measure the DC current taken from the 12V supply. If the power input to the inverter is about equal to the rated power output of the CFL, then all is well. If not, the wrong type of CFL is being used...

The circuit

The circuit of the inverter is shown in Fig.4. The main component is IC1, type SG3525. This IC is designed for use in switch-mode power supplies, and features totem pole output drivers that can quickly charge and discharge the input capacitance of the MOSFETs. This improves the efficiency of the inverter, as the turn-on and turn-off times of the MOSFETs are kept extremely short.

The oscillator timing components are C2 and R1, with a charge time of 12us and a discharge time of 1us, giving an operating frequency of about 75kHz. Capacitor C4 provides a 'soft start' and is charged by an 50uA constant current source inside IC1. This causes the duty cycle of the output signal from pins 11 and 14 of IC1 to slowly rise to 50% as C4 charges.

A soft start is needed because of the relatively large filter capacitor in an electronic ballast or a CFL. Further start-up current limiting is provided by R4, which for best reliability is specified as a wire-wound 5W resistor.

The inverter section consists of a push-pull inverter with the two primary windings of T1 connected to form a centre tap. The primary current is switched via MOSFETs Q1 and Q2. The secondary voltage is directly proportional to the turns ratio of the transformer, and is therefore determined by the DC voltage supplying the circuit.

The secondary voltage from T1 is converted to DC by a bridge rectifier comprising four high speed diodes. The usual output voltage is around 350V DC. The output voltage is not regulated unless it exceeds 370V, as regulating the voltage lowers the efficiency of the inverter and is not necessary in this application anyway. The reason is that a CFL or an electronic ballast can operate over a wide voltage range, with a relatively constant light output.

Because of the leakage inductance

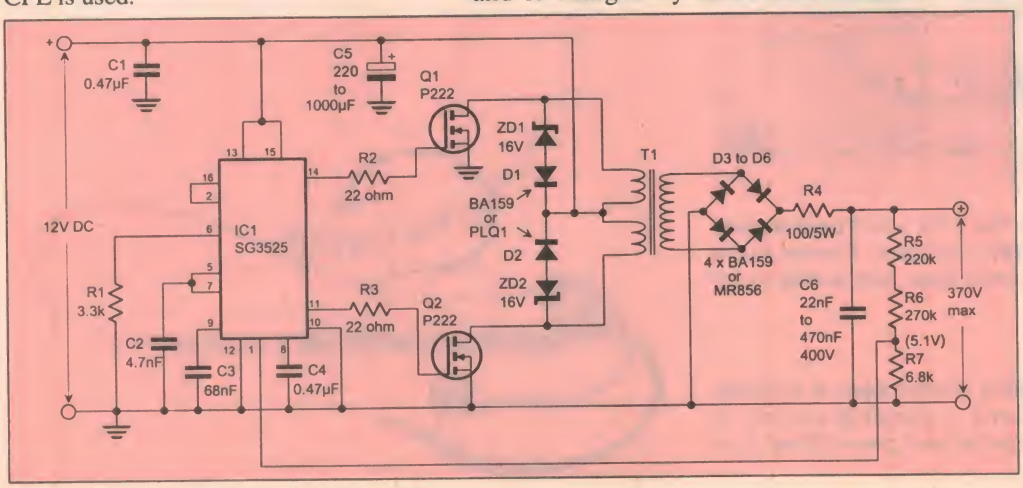


Fig.4: The circuit consists of a double ended inverter with the two primary windings of the transformer connected to form a centre-tap. The MOSFETs are driven with a square wave from IC1. Regulation of the circuit only occurs when the output voltage exceeds 370V DC.

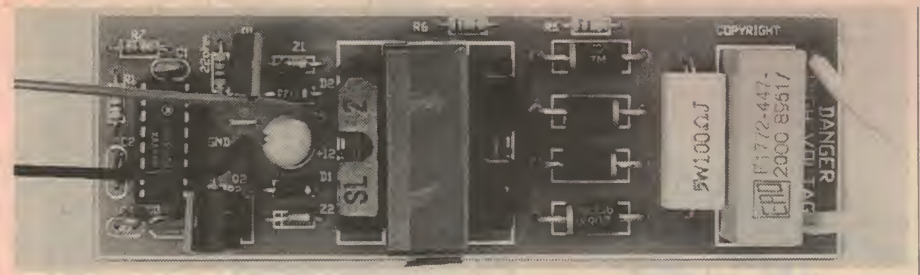


Fig.5: This photo shows a close up of the inverter PCB. The MOSFETs in this board are type MPT50N05E and have a different package to the specified P222 devices. See the layout diagram for details.

between the two primary windings of T1, spikes are generated at the drain terminals of Q1 and Q2 when these devices switch off. The spikes are clipped by ZD1 and ZD2, to prevent damage to the diodes in the bridge rectifier connected to the secondary of T1. Diodes D1 and D2 prevent the zener diodes conducting in the forward direction.

Construction

The kit of parts for the inverter includes a silk screened PCB that shows the component layout. Assembly is therefore very straightforward. The photo in Fig.5 shows a close-up of the inverter and Fig.6 shows the layout diagram.

As usual, install the passive components first, taking care with the polarity of the diodes and the electrolytic capacitors. An IC socket for IC1 is optional.

If the inverter will only be used with 20W loads or less, there's no need to add a heatsink to the MOSFETs. For 40W loads, you have two options: fit heatsinks to the P222 MOSFETs, or use MOSFETs type MPT50N05E. These latter devices are in a TO-220 style package which has a metal tab. They also have a higher current rating than the P222 devices. While they can power a 40W load without a heatsink, for best reliability a small heatsink should be added.

The P222 devices are in a TO-126 style package, but without the usual hole drilled through the package. This means the heatsink has to be of the clip-on type, as there's no way of otherwise attaching it. As we've said, the heatsink is only needed if you want to use the inverter with a load greater than 20W.

Testing

Once you've built the inverter, connect a suitable load to the output and apply 12V DC to the input. It's important to add a fuse between the battery and the inverter. Otherwise a fault could cause a large battery current to flow, causing considerable heat in the conductors and damage to the circuit. A 5A 3AG fuse in an in-line fuse holder will suit most applications.

Remember also that the output voltage is a lethal 350V DC. For this reason, use 240V mains rated wiring from the output of the inverter.

As a guide to its operation, the prototype inverter takes about 180mA from a 12V battery when no load is connected. When a Philips PL Slimline Electronic 20W CFL is connected to the inverter, the battery current is about 1.8A. As the light warms up, the current drops slightly. If the load current is excessive and the no-load current is correct, suspect the load. (Refer back to the sec-

Continued on page 87

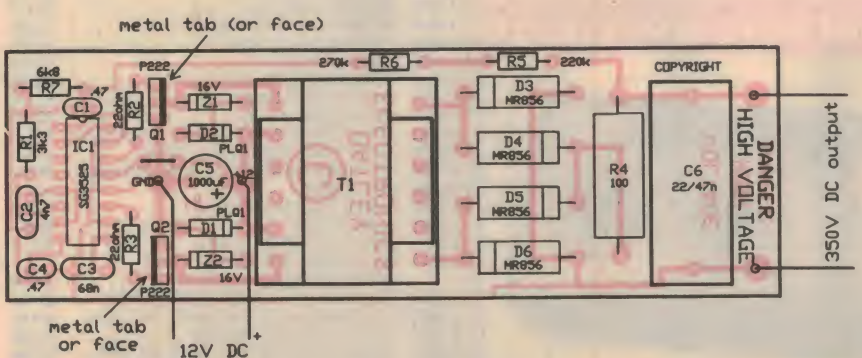


Fig.6: Here's the layout of the PCB. The MOSFETs can be either of two types, but both are installed with the metal tab or metal face as shown.

OUR EXPANDING & NEW PRODUCTS FOR 1995!

We are commited to delivering the latest in computer products & accessories!

SECURITY KIT

NEW

Safely secure your valuable equipment from theft. Quick & simple to install.

Simply stick the mounting plates to any computers, office equipment, home entertainment systems, small appliances or any piece of valuable equipment and chain up.

Includes • heavy duty 7½' ft coated steel cable • 3 permanent self adhesive mounting plates • 1 padlock and 2 keys.

GREAT FOR SHOPS, SCHOOLS, GOVERNMENT DEPARTMENTS, COMPANIES, ARMY SERVICES, ETC, ETC.

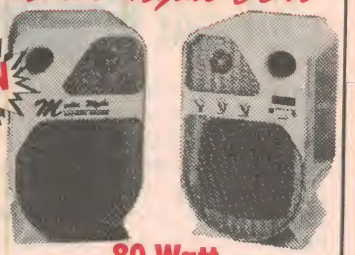
GREAT VALUE!!

CAT No. A15206
$19.95

NEW AMPLIFIED STEREO SPEAKERS FOR YOUR MULTIMEDIA SYSTEMS:

NEW

Media Myths 80W



80 Watt with • 4" woofer, 2" tweeter & 14W amplified (per side) • Audiio control for volume, tweeter & woofer • Frequence response: 20Hz-20KHz • J.H.D: under 0.03% • Dimension: 140W x 220H x 170D mm • Gross weight: 4.8kg.

AVAILABLE TO ORDER BY MAIL ORDER

80 Watt

$129.00

Magnectically shielded for low noise & to prevent damage to disk & distortion of video display

AVAILABLE TO ORDER BY MAIL ORDER

Media Myths 30W

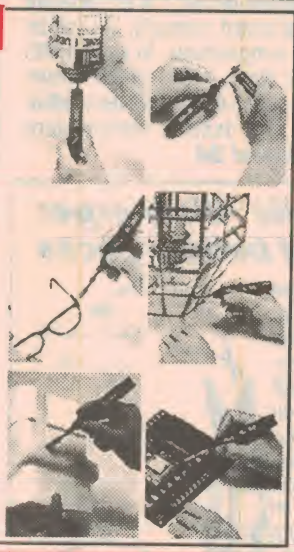
NEW

30 Watt

$79.95

30 Watt with • 3" woofer 6W amplified (per side) • Audiio control for volume, tweeter & woofer • Frequence response: 70Hz-16KHz • J.H.D: under 0.05% • Dimension: 108W x 175H x 1100D mm • Gross weight: 2.0kg.

NEW 6 TOOLS IN 1 HOT-SOL SERVICE KIT



A multifunctional tool holder that can be used for:

- Soldering (up to 400°C)
- Heat Shrinking
- Repairing
- Cutting
- Torch(up to 1300°C)

Runs on standard butane gas lighter fuel. Up to 60 minutes continous use. 5 tips included.

T12660
$29.95

NEW LOWER PRICES!!

IEC TO 3 PIN MAINS CABLE

P10252
WAS $9.95
$7.95

IEC EXTENSION CORD (M-F)

P10254
WAS $14.95
$9.95

Save $5.00

EXTRA LENGTH LAPLINK CABLES

NEW

CONNECTED YOUR OFFICE COMPUTERS AND TRANSFER FILES EASILY- SAVE YOURSELF LOTS OF TEDIOUS DISK COPYING.

"LAPLINK" (make 2 computers talk to each other). Stop going through the tedium of copying to and from floppy disks. Ideal for Laptop to Desktop file transfer, usergroup meetings, etc. Dos 6.0, 6.2. INTERLINK.EXE works like a basic network with only 1 client and 1 server allowing for shared resources like printers and hard drives. Use either a serial or parallel (bi-directional) port. Use a Ritronic Laplink cable serial (P19070) or parallel (P19072).

Follow the simple instructions in your DOS manual:-

i.e. Edit your config.sys on the client computer by adding the line: *device=c:\dos\interlink.exe* Restart your computer. Crtl+Alt+Del

On the server run the program **INTERSEV.EXE**

For more information type ***help interserv*** at the DOS prompt and read the on screen txt.

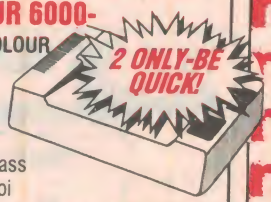
These cables are suitable only for exchanging data between systems & not for playing interactive games such as Doom, Rise of the Traid, Wacky Wheels, Descent, etc. You will need a serial cable such as the Serial Combination Cable F/F9 and 25 pin (P19070).

P19073
5M PARALLEL DB25 M/M
$14.50

P19074
10M PARALLEL DB25 M/M
$19.50

SUPA SPECIAL

SCANPLUS COLOUR 6000-

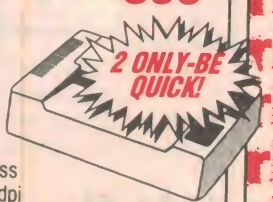


2 ONLY-BE QUICK!

24 BIT 16.8 MILLION COLOUR SCANNER • IBM PC/ AT38/486/PS2 & MAC COMPATIBLE • Full page 216mm max scanning width • High speed (one pass scanning for RGB) • 600dpi

X17120 WAS $909 NOW $399

SCANPLUS 600-



2 ONLY-BE QUICK!

FULL PAGE GREYSCALE SCANNER • IBM PC/ AT38/486/PS2 & MAC COMPATIBLE • Full page 216mm max scanning width • High speed one pass greyscale scanning • 600dpi

X17110 WAS $699 NOW $299

RIE- THE PLACE IN TOWN FOR THE LATEST VALUE-PACKED MULTIMEDIA SYSTEMS! LATEST PENTIUM™ PCI PRODUCTS

SUPA 486DX-2 66 MULTIMEDIA

486DX2-66 /420MEG HDD VESA LOCAL BUS 3 SLOT MOTHERBOARD FITTED

This powerful 486DX2-66 system is perfect for the multimedia world of music, animation and interactive software. Up to $1000 worth of FREE software! Including word processing, spreadsheet, database, encylopedia, dictionary, game, etc. You can't get better value than this!

INCLUDES: • VESA Slot Motherboard • 4MEG RAM • Mini Tower Case and 200W P.S. • 1.44 3.5" F.D.D. • VESA 1 MEG SVGA Card • 14" SVGA non interlaced Monitor - 1024 x 768mm 0.28mm Dot Pitch • Ritron Mouse Pad • 101 High quality keyboard • 16-bit Sound Card • Joystick & Mouse • Multispin CD ROM Drive • Magnetically Shielded Speaker • Microphone • Windows 3.11 • MS-DOS 6.22

5 FREE CDs

• Microsoft Works • Microsoft Encarta '95 • Microsoft Golf • Microsoft Multimedia Beethoven • Microsoft Dangerous Creatures- *Tremendous Value!!*

• *20Mbytes worth of FREE shareware games*

OPTION:

FITTED WITH CREATIVE *LATEST* QUAD SPEED CD-ROM DRIVE ..... $2299 Inc Tax.

4 YEAR PARTS & LABOUR WARRANTY (FIRST 2 YEAR ON-SITE) MELB MET AREA

PCI CREATIVE SOUNDBLASTER PENTIUM™ SYSTEM

LATEST TECHNOLOGY - PENTIUM™ 60/66 MOTHERBOARD

True power-user configuration, with super-fast PCI components. This system offers the power computing you have been waiting for! Whizz through the most complex applications and gain higher productivity. Computing as it should be! Don't get left behind with old & slow technology.

540MB HDD FAST ATA BUS CONT CARD

Configuration: • PCI Slot Motherboard • PCI I/O Card • 8 MEG RAM • PCI 1 MEG SVGA Card • 14" SVGA Non interlaced Monitor - 1024 x 768mm 0.28mm Dot Pitch • Mini Tower Case and 200W P.S. • 1.44 3.5" F.D.D. • Ritron Mouse Pad • 101 High quality keyboard • Sound Blaster 16 Sound Card • Joystick & Mouse • Magnetically Shielded Speakers • Latest Creative CD ROM Drive • MS DOS 6.22 • Windows 3.11

INCLUDE 5 FREE CDs:

• Microsoft Works • Microsoft Encarta '95 • Microsoft Golf • Microsoft Multimedia Beethoven • Microsoft Dangerous Creatures-

• *BONUS: 20 MEGABYTES WORTH OF SHAREWARE GAMES.*

FREE 3 HOUR COMPUTER TRAINING COURSE- MELBOURNE ONLY

4 YEAR PARTS & LABOUR WARRANTY (FIRST 2 YEAR ON-SITE) MELB MET AREA

USE YOUR DINERS CLUB/AMEX CARDS TO GAIN FLYER POINTS! APPLYS TO THIS MULTIMEDIA SYSTEM PRODUCT OFFER ONLY

24-BIT FLATBED COLOUR SCANNER

ColorPage-II 2400 dpi flatbed SAVE $500!!

3 ONLY!!

WAS $1799 NOW... $1299

• *Brilliant colour* - 24 bit true colour images for your Window-based DTP & presentation packages • *High resolution* - up to 1200 dpi. • *Powerful image software* - PhotoFinish 3.0 software for image editing. • *TWAIN compliant* -scan easily within any compatible applications. Simply select the acquire scanner command. OPTIONAL: • *Power OCR* - optional Recognita Plus OCR. Auto-Document Feeder (ADF-I) and transparency unit (TMA-1). *INCLUDES: INTERFACE CARD, PHOTOFINISH 3.0, MEDIAMATE PRESENTATION SOFTWARE, TWAIN DRIVER, USER'S MANUAL*

Scanmate 256

offers 256 grey scales scanning at an affordable price. Scans up to 800 dpi resolution. **Include:** Interface Card, Photofinish 3.0, Media Mate presentation software, SmartPage Direct OCR software, TWAIN compliant software, User's Manual, etc.

Scanmate Colour

Economical 24-bit 16.7 million true colour scanning without the big price tag. Includes: • Photofinish 3.0 image editing software • Up to 800 dpi • Twain compliant- scan from within other compatible applications • Smartpage Direct OCR software *Include interface card, Mediamate Presentation software & User's Manual*

DYNALINK MODEMS

1414VQE High speed desktop fax modem V.32bis (14.4 kps) data & fax modem **$299**

1414VQH High speed IBM card fax modem V.32bis (14.4 kps) data & fax modem **$229**

Bundled with WinFax Lite

Easy Painter $179
Digitiser pad for freehand drawing

HiMouse Cordless .. $79
Control cursor up to 2 meter

Laser Pointer $79
Highlight what you want in your presentations!

Scanmate 1600DPI Colour

Economical 24-bit 16.7 million true colour *1600dpi* hand-held scanner. Includes: • Photofinish 3.0 image editing software • Up to 1600 dpi • Twain compliant- scan from within other compatible applications

NEW AN AMAZING $499

NEW!! SECURITY KIT

Safely secure your valuable equipment from theft • For home & office use • Quick, simple to install • Includes 71/2 feet of coated steel cable, 3 self adhesive mounting plates, 2 keys & 1 padlock

ONLY $19.95

EPSON PRINTERS

LX300 *264 Cps Draft, 9 pin dot matrix*	$249
With colour option	$349
LQ100 *200 Cps Draft, 24 pin dot matrix*	$289
LQ150 *216 Cps Draft, 24 pin dot matrix*	$339
With colour option	$389
Stylus 400 *48-nozzle inkjet, 180Cps, 360dpi*	$389
Stylus 800+ *48-nozzle inkjet, 255Cpi, 360dpi*	$459
Stylus Colour *200Cpi, 360/720dpi full colour*	$889
EPL 3000 *300dpi, 4ppm, laser printer*	$849
EPL 5200 *300dpi, 6ppm, laser printer*	$1149
EPL 5600 *600dpi, 6ppm, laser printer, RISC*	$1599

NEW!! COMPUTER CASES

MINI TOWER CASE .. $69
MIDI TOWER CASE .. $89
FULL TOWER CASE . $119
All cases come with 200watt power supplies

RITRON COMPUTER SYSTEMS NOW WITH 420 MB H.D.D.

CPU TYPE	TAX EX.	TAX INC
386DX-40	$1029	$1229
486DX2-50 Cyrix	$1179	$1426
486DX2-66	$1239	$1479
486DX2-80	$1355	$1639
486DX4-100	$1485	$1796
Pentium™ 60*	$1525	$1845
Pentium™ 66*	$1599	$1895
Pentium™ 75*	$1699	$2055
Pentium™ 90*	$1979	$2379
Pentium™ 100*	$2390	$2891

GREAT VALUE!!!

*External 256K Cache

4 YEAR PARTS & LABOUR WARRANTY

All systems include: 4 MEG RAM • 420 MEG H.D.D. • *GREAT VALUE!!* • 1.44 MEG 3.5 FDD • Mini or Baby AT casing • 2 SPG Ports • 101 Keyboard • 3 Slots VESA Local Bus Motherboard • 14" SUPER VGA (1024 X 768) (0.28" DOT PITCH) Colour Monitor • VLB 1MB VGA Cards are supplied in 486 machines AT NO EXTRA COST (Up to 1280 x 1024) *Pentium systems now come with PCI Cards and should be bought with 8MB of RAM*

DISCOUNTED SOFTWARE

DOS 6.22	* $89
M.S WORKS	* $99
DOS 6.22 & Win 3.11	* $139
DOS 6.22 & Windows for Workgroups	* $159
MS MONEY	* $39
MS BOOKSHELF	* $99
MS Office Pro	* $775
MS Office Pro Deluxe *(As seen on T.V.)*	*$869
MS Encarta '95	* $99
MS Dangerous Creatures	* $60

*When purchased with a system only.

TERRIFIC VALUE OEM 4 CD PACK*
•Dangerous Creatures
•MS Golf •MS Works
•MS Encarta'95
•MS Money
$179
*When purchased with a system

FREE 3 HOUR TRAINING COURSE (MELB. ONLY) FOR ALL COMPUTER SYSTEMS INCLUDING MULTIMEDIA SYSTEMS

UPGRADES & PERIPHERALS FOR YOUR SYSTEMS

SUPA MOTHERBOARD UPGRADES

386SX-40* LM 47	$149
386DX-40* 128K Internal Cache LM58	$229
486DX2-66#256K Cache L.B	$349
486DX2-80* 256K Cache L.B *NEW!*	$449
486DX4-100* 256K Cache L.B	$499
PENTIUM™ 60MHz/256 C VESA/PCI	$649
PENTIUM™ 66MHz/256 C VESA/PCI	$726
PENTIUM™ 75MHz@/256 C VESA/PCI *NEW!*	$999
PENTIUM™ 90MHz@ PCI/VESA	$1299
PENTIUM™ 100MHz@ PCI/VESA	$1995

*AMD CPU, #CYRIX CPU Without Asterisk- INTEL CPU @ Come with I/O Card fitted on motherboard

HARD DRIVES VOICE COIL IDE HD

Cap	Av.Access	1ax Inc.	1ax Ex.
260M	16ms	$269	$222
345M	12ms	$278	$230
420M	12ms	$327	$270
540M	12ms	$375	$310
#850M	10ms	$469	$390
#1.08GB	10ms	$617	$510
#1.27 GB HD	10ms	$720	$600
#1 GB SCSI HD	10ms	$999	$825
#1.7GB SCSI HD	10ms	$1490	$1231
#2.15GB SCSI HD	10ms	$1999	$1652

#These drives come with Disk Management Software to overcome DOS limitations (Drives will normally go to 528MByte max).

CD ROM DRIVES

NEW QUAD SPEED CD ROM DRIVE	$549
WEARNES CDD-110 DUAL SPEED CD ROM IDE DRIVE *instructions & software (Sony interface)*	$199
WEARNES CDD-120 DUAL SPEED CD ROM IDE DRIVE *with inst & software (CD-I Compatible)*	$199
562B CD ROM DRIVE DOUBLE SPEED *with software drivers for all drives*	$199
563B CD ROM DRIVE DOUBLE SPEED *works with all Sound Blaster Cards*	$289
NEW QUAD SPEED TEAC CD ROM DRIVE	$349

SOUNDBLASTER CARDS

NEW Sound Blaster Pro VALUE EDITION with Lemmings & Indy 500	$110
Sound Blaster Deluxe	$65
Sound Blaster 16 bit	$179
Video Blaster SE100	$499
Game Blaster CD16 Pk 7 CD Titles	$799
TV CODER	$279
16 bit Discovery Pack CD16 *2 LEFT ONLY*	$489
8bit Discovery Pack CD8	$299
NEW Quad Speed CD-ROM Drive	$649

MEMORY

	1-9	25+	100+
30 PIN SIMM			
1M x 9-70 With Parity	$69	$67	$65
4M x 8-70 No Parity	$249	$238	$234
4M x 9-70 With Parity	$259	$255	$249
72 PIN SIMM FOR PENTIUM™		*Processor M.B.*	
4M X 8-70 No Parity	$269	$259	$249
4M X 9-70 With Parity	$289	$285	$279
8M X 9-70 With Parity	$529	$519	
16M X 8-70 No Parity	$899	$879	
16M X 9-70 With Parity	$999	$979	

NEW MONITOR RANGE!

All these superb monitors on display at all stores

• 14" Interlaced 1024x768 (0.28mm Dot pitch)	$389
• 14" Non-interlaced 1024x768 (0.28mm Dot pitch)	$429
• 15" XGA Analogue 1280x1024	$539
• 15" XGA Digital MPRII 1280x1024	$649
• #17" XGA Digital MPRII 1280x1024	$1049
• #17" XGA Digital MPRII 1600x1280 (0.26mm Dot Pitch)	$1495
• *NEW!!* 20" XGA Digital MPRII	$1999

#15" & 17" Digital Monitor comes with Economy Management Software

MAESTRO MODEMS *LOWER PRICES!

144M INTERNAL 14400BAUD	$179
144M EXTERNAL 14400BAUD	$209
144FM INTERNAL 14400BAUD	$329
144FM EXTERNAL 14400BAUD	$349
28.8 FAXMODEM EXT 28,800BPS	$479
28.8 FAXMODEM INT 28,800BPS	$449

FM MEANS FAXMODEM

BULK DISK PRICES

PRICES ARE PER BOX OF TEN DISKS

All disks come with Write Protects and envelopes and a life time warranty

DESCRIPTION	1-9	10+	50+	100+	500+
5¼ DS/DD	$4.50	$4.50	$4.50	$4.30	$3.95
5¼ DS/HD	$7.95	$7.75	$7.50	$6.90	$6.90
3½ DS/DD	$5.95	$5.75	$5.50	$5.25	$5.00
3½ DS/HD	$5.95	$5.75	$5.50	$5.25	$5.00

rie ROD IRVING ELECTRONICS PTY. LTD.

FREE CATALOGUE

FOR THE SERIOUS COMPUTER USER Est. 1977 A.C.N. 005 426 437 ERRORS & OMISSION EXCEPTED. PRICES CHANGE WITHOUT NOTICE.

HEAD OFFICE: 56 Renver Rd Clayton, Victoria, 3168 Ph: (03) 543 7877
MELBOURNE: 48 A'Beckett St. City. Ph:(03) 663 6151. Computers (03) 639 1640
VERMONT: 190 Rooks Rd. Ph: (03) 874 8888. Fax:(03) 874 2288
OAKLEIGH: 240C Huntingdale Rd. Ph: (03) 562 8939. Fax:(03) 562 8940
NORTHCOTE: 423 High St. Ph: (03) 489 8866. Fax:(03) 489 8131
BOX HILL: 1031 Maroondah Hwy. Ph: (03) 899 6033. Fax:(03) 899 0156
ADELAIDE: 241-243 Wright St. Ph. (08) 211 7200. Fax:(08) 211 7273
SYDNEY: 74 Parramatta Rd, Stanmore. Ph: (02) 519 3888. Fax:(02) 516 5024

BLUESTAR COMPUTERS: 271 Maroondah Hwy. Ringwood Ph: (03) 870 1800
Fax:(03) 879 3027 TRADING HOURS: Mon/Fri 9am - 5.30pm.Sat 9am - 1pm

City store open till 8pm on Fridays. Box Hill store open till 3pm on Saturdays.
Tax Exempt sales: RITRONICS WHOLESALE Ph.(03) 543 2166 Fax.(03)543 2648
RIE BULLETIN BOARD Ph: (03) 562 7877 For Specials, info & Shareware
MAIL ORDER: Ph:(03) 543 7877 Fax:(03) 543 8295
Mail Order Hotline 1-800 33 5757

EAJUN95

Construction Project:

SINGLE CHIP CHESS COMPUTER

Keen on chess? How would you like to build your own low-cost chess computer, so you can pit your skills against it? Here's a design based on a single microcomputer chip, with firmware developed by the author. It uses surface mount technology, and is so compact you can either fit it into a matchbox or build it into a conventional chessboard...

by IAN MITCHELL

'Chess is the intellectual game *par excellence*', wrote Newell, Shaw and Simon in their paper published in the IBM *Journal of Research and Development* in 1958, which traced the development of digital computer programs that play chess. They believed that the efforts to program chess provided an indication of the then-current progress in understanding and constructing complex and intelligent mechanisms.

I think this probably holds true today, as just recently a computer called DEEP THOUGHT has won a chess game against a Grand Master chess player. However, it took one of the fastest parallel computers in the world and many man-years of programming effort to do it.

Chess programs have probably been written for all types of digital computers ever constructed in the last 40 years, from four-bit microcomputers to Crays and all types in between.

Presented here is a chess computer based on the 68HC705C8FN microcontroller from Motorola. The 'FN' refers to the type of package the micro controller comes in, which in this case is a plastic-leaded chip carrier or PLCC. It's a surface mounted component and allows the project to fit into a match box! It is not necessary to construct the project this way, but it will certainly be a novelty if you do.

Of course if you decide to construct the project to fit into a match box (or something similar) then a normal chess board must be used in conjunction with it in order to play against it. Alternatively you could build it into your own chess board and thus have a fully self contained chess computer, like most of those available commercially. I plan to build one with a glass top and legs, so that it can double as a small coffee table. I have called it the Single Chip Chess Computer, or 'SC3'.

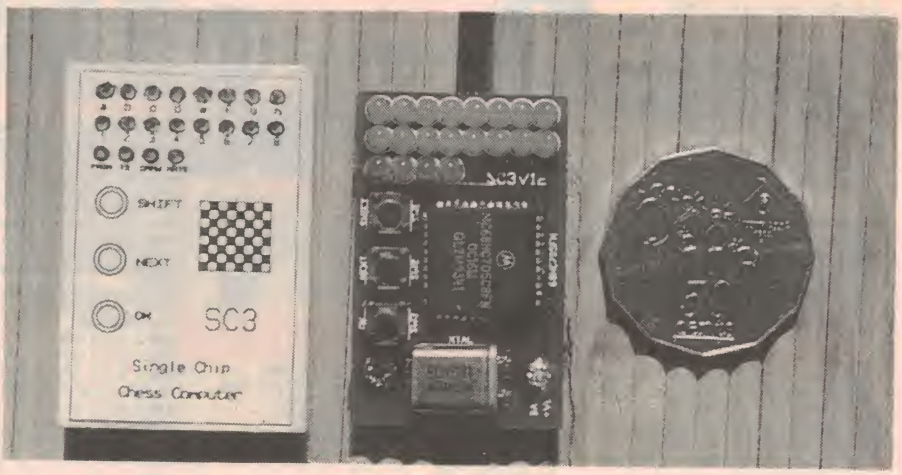
The circuit

The SC3 consists of three switches for entering moves, and four banks of LEDs for displaying moves and status information. There is no on/off switch, since the microcontroller is placed into its low power or STOP mode whenever a switch has not been pressed for about eight minutes ago. During STOP mode, the on-chip clock is stopped and power is only required to keep the static RAM from losing its contents — which requires about 10mW.

Only one of the LEDs from each bank will be used at any one time, so only one current limiting resistor is needed per bank of LEDs. The separate banks are multiplexed to give the illusion of more than one LED being on. Debouncing of the switches is handled by software, and is incorporated in the same routine as the LED multiplexing. The multiplexing routine is called with parameters to indicate which LEDs to multiplex.

During multiplexing, the port to which the switches are connected is examined, and if a switch was already closed the routine waits until the switch becomes open. At which point a delay of several loop times is used to debounce the switch opening, and the routine then loops waiting for a switch closure. When a switch being closed is sensed, another delay for debouncing is initiated after which the routine returns with the identity of the switch which was pressed. A delay in the multiplexing loop determines the rate of display multiplexing, which is about 7ms.

Switch SW3 is also connected to the interrupt request (IRQ) pin, which enables the microcontroller to wake up from its low power mode. Also, if you



The author's prototype chess computer PCB is shown here in the centre, slightly smaller than actual size, with its matchbox 'case' on the left and a 50 cent coin on the right to give an indication of their size.

get tired of waiting for the computer to make its next move, you can press this switch to interrupt the routine which is calculating the next move, and force the computer to use the best move it has found so far.

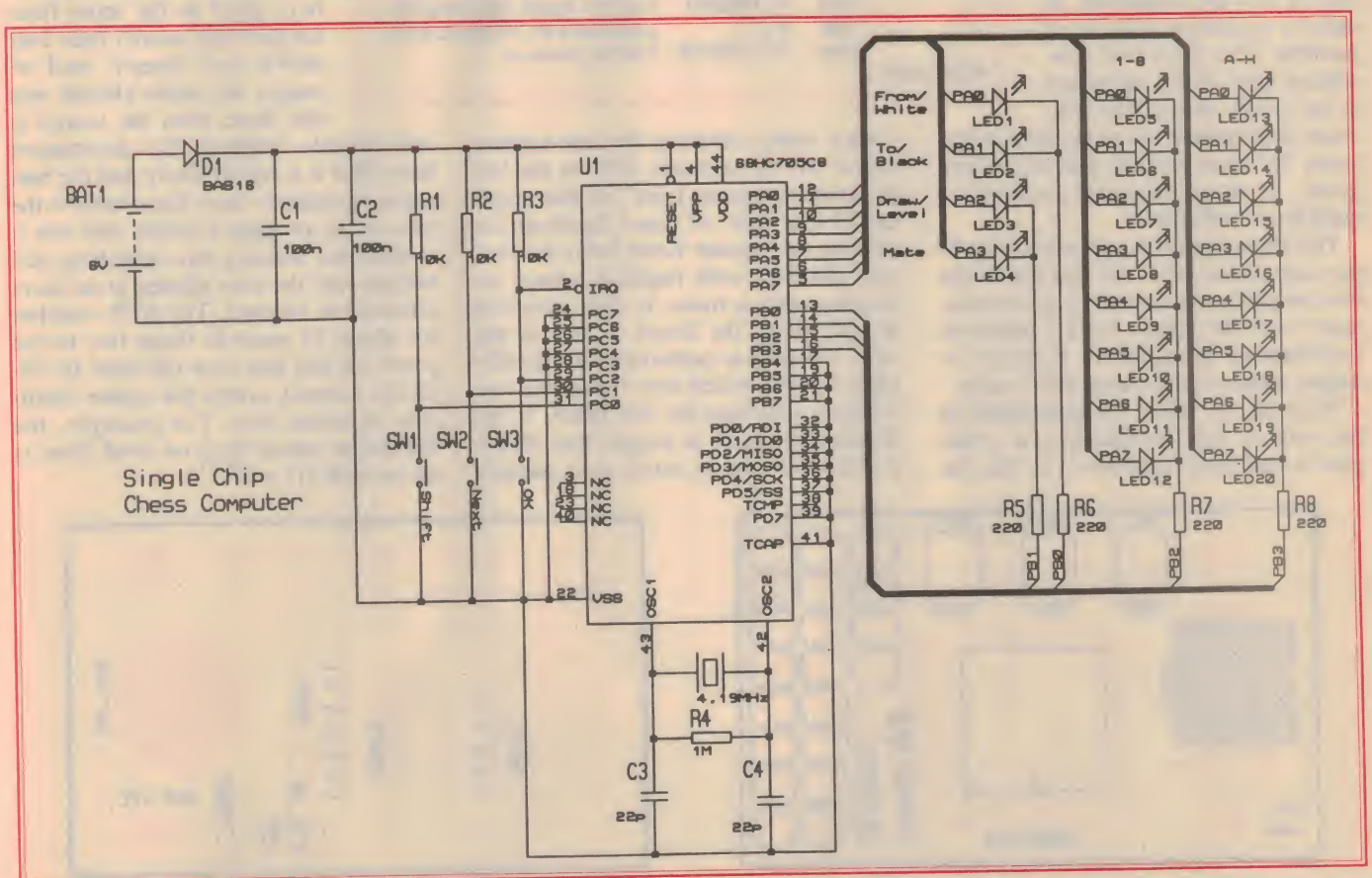
A 4.1943MHz crystal is used in the clock circuit because they are readily available and the maximum clock frequency for this particular device is 4.2MHz. This is divided internally by two, giving a bus clock of 2.097MHz. Capacitors C3 and C4 and resistor R4 are used to ensure reliable starting of the oscillator.

All unused inputs are tied low, so as to prevent increased power consumption should these inputs otherwise stray up and down. Diode D1 is used to reduce the peak voltage of fresh batteries by about 0.7 volts and also protects the circuit from inadvertent reverse connecting of the batteries.

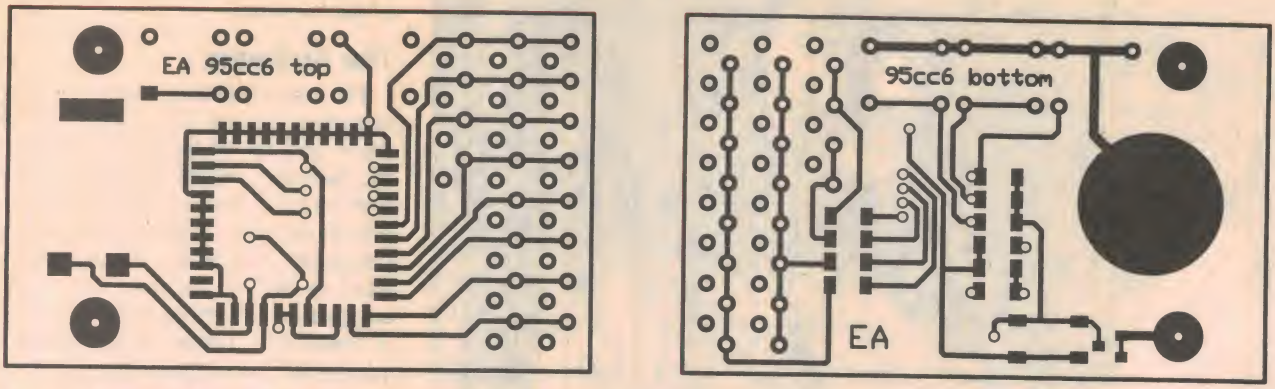
The firmware

The main building blocks of a chess computer are the CPU, RAM, ROM, a timer and an appropriate input/output mechanism. Apart from the lack of processing power in the CPU a typical microcontroller makes an ideal chess computer. Depending on the algorithm used to decide the next move for the computer, it has been shown clearly that a computer's chess rating increases in proportion to its processing power for a predetermined period of time per move. While we can't expect a chess computer based on a microcontroller to play at the level of Grand Master, a reasonable level of play can be expected while a bad move is not necessarily a bug in the program. It is also clear that as more time is devoted to the calculation of a move, the better that move is likely to be.

The firmware for the SC3 consists of approximately 6000 lines of assembly code, so a detailed explanation of its function cannot be undertaken here unfortunately.



As you can see, the circuit is based almost completely on a Motorola 68HC705C8 microcontroller chip. Twelve LEDs are used to indicate the status of the game, and also to read out the computer's moves.



Here are the patterns for the top and bottom layers of the chess computer PCB, for those who like to etch their own boards. Note however, that because this board is very small we've reproduced them at 150% of actual size for clarity.

The program was originally written in C, in order to test and debug the algorithms, and then translated into 6805 assembly language. Even so, using this method still required about two years of part-time programming to complete.

Why is the program so long? The answer, in a word, is speed. Due to the nature of the algorithm (described below) for generating and searching moves in order to find a good one, it is very important to make it execute as quickly as possible. The most time consuming part of the algorithm is the move generation. Because determining the next move is certainly the 'most visited' part of the program, it must execute reasonably quickly and efficiently.

The chess board is represented by 64 memory locations, with the pieces for the computer represented by positive integers and the pieces for the opponent represented by negative integers. A vacant square is represented by a zero.

With this in mind, the generation of the moves for the black and white pieces has been separated, as has the generation of capture moves as opposed to non-capture moves (also explained below), and where possible loops have been unrolled and code placed in-line. A sample piece of code for generating a rook's move is shown in listing 1.

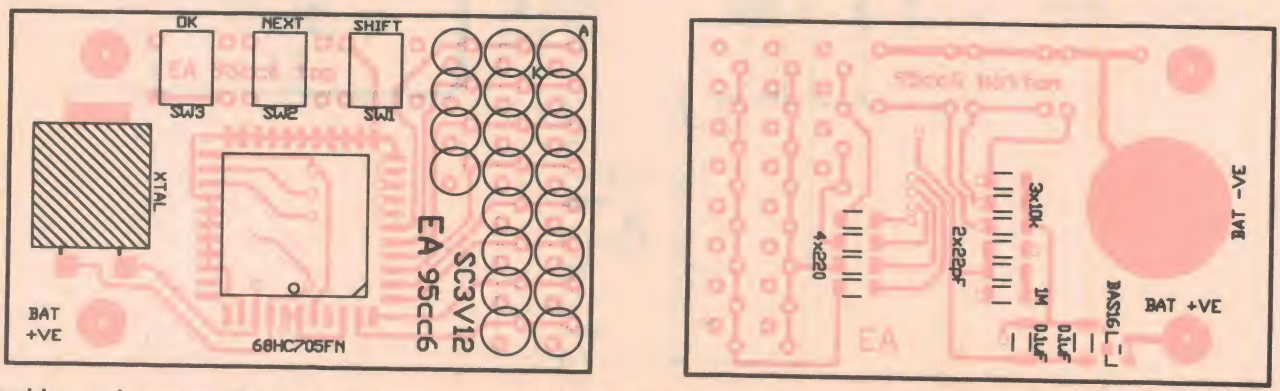
NCRDIR0 is where program flow comes when checking for non-capture moves involving rooks. PTO is the last destination square tried for this rook. DIRN is a table of board locations for moving one square north from the current position, with negative values indicating that a move in that direction would be off the board. If this is the case, a branch is performed to a similar piece of code which tests for moves in a different direction for this piece. If the destination square is vacant, then this is a valid move in as much as it ensures that the king has not been placed in check because of this move.

Listing 1

```
NCRDIR0     ldx   PTO        index TO position
            ldx   DIRN,x     get next board position
            bmi   NCRNDIR1   if off the board, next direction
            lda   B,x        see what's on the board here
            beq   RET_MOVE   if blank, move ok
NCRNDIR1 ...
```

Both the C and the assembly versions are available on floppy disk, if you are interested in understanding the code in more detail.

The SC3 has eight levels of play, which correspond directly to the amount of time it spends calculating the next move. However if the score associated with the latest search is as good as the score from the previous search (one half move less deep), and of course the move chosen was the same, then the search is immediately stopped. The assumption being that it is highly likely that the best move has already been discovered to the best of the program's ability and that it is pointless wasting time searching still further until the time allotted at the level chosen has elapsed. The SC3 searches for about 11 seconds times two to the power of one less than the level of difficulty entered, unless the above condition becomes true. For example, the maximum search time on level three is 44 seconds ($11 \times 2^{(3-1)}$).



To guide you in assembling the chess computer, here are the overlay diagrams for the top and bottom of the board. The small surface mount components and battery fit on the underside of the board, with the crystal, chip and LEDs on the top.

The SC3 uses what is known as a 'brute force' method of calculating the next move. This method appears to be the method of greatest success, historically, in terms of playing human opponents. Its advantage is that every single move on the board will be tried and evaluated and thus the very obviously bad moves will always be eliminated. Other methods, which employ some intelligent scheme of selecting which moves to consider, were not as successful because it is extremely difficult to program such intelligence into a machine.

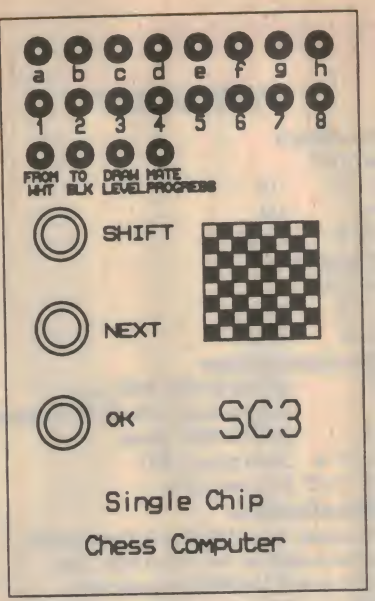
The method by which the SC3 uses to determine its moves is a derivative of a searching technique called the *minimax algorithm.* The minimax algorithm works by considering, for example, all the moves from the current board position, and for each of those moves, all the replies to those moves; and so on, to a predetermined depth or level. At which point (a terminal position) a score is calculated based on how good the position is...

In the SC3 the score is calculated by considering the material balance only. In theory it is possible, from the beginning of the game, to search all the moves until either a win, draw, or loss has been found. In practice this is impossible due to the sheer magnitude of the moves that would need to be searched. For example, if on average there are about 40 moves available in any given position, then searching to a depth of only 10 levels (or ply) would require the generation of 4010 or 1016 moves!

The minimax algorithm gets its name from the way it works. That is, the computer will choose the move leading to the position at the next level with the maximum score, knowing that where it is the opponent's turn, a score equal to the minimum score of any of its successors is chosen.

The minimax algorithm is a depth-first search, and by its nature the memory requirements grow linearly with the depth of the search — as opposed to breadth-first searching, for example, where the memory requirements grow exponentially with the depth of the search. This is an important consideration because of the limited amount of RAM available on the 68HC705 for this application.

The actual algorithm used, however, is a derivative of the minimax algorithm called the 'alpha-beta search' algorithm. This algorithm is based on the fact that many paths within the search tree constructed by the minimax algorithm need not be examined because they will have



The artwork for the chess computer's front panel, reproduced again at 150% for clarity.

no effect on the outcome of the search. The decision whether or not to search a particular branch of the tree is based solely on the numeric value of the score calculated at the terminal nodes. It has been demonstrated that the alpha-beta algorithm requires only six times as long to search the next level in chess, compared to the minimax algorithm where it is dependent solely on the number of moves at a given position.

Because of the nature of the alpha-beta search algorithm, the order of moves visited will impact heavily on the number of positions searched, and thus the duration of the search. Most chess programs will generate all the moves at each level and then sort them in order of value, defined by a comparatively quick evaluation routine. For example, a queen captured by a pawn will rate higher than a pawn captured by a bishop, and so forth.

Since the 68HC705 has very limited resources in terms of RAM it is impossible to generate, store and sort all the moves at each level, so a compromise is made. It turns out that it is only necessary to store enough information to determine what the next move will be, each time the move generation routine is called. Only nine bytes of information is required at each level to uniquely identify the move made in a particular position, and the same information is of course used to restore the board after the move has been searched.

Using this method it's not possible to directly sort the moves to improved the search time. However it is possible to improve the search time by dividing the move generation into two separate sections, the first of which generates all the capture moves and the second all the non-capture moves. This sometimes involves scanning the board twice, but the savings in search time easily make up for this. If there is a capture move in any given board position it is highly likely that based on the properties of the alpha beta search algorithm, the second scan of the board will not be required.

As described before the score evaluated at the terminal positions of the tree is based on the material balance. Whilst this is certainly an important piece of chess knowledge, it is by no means the only piece.

The SC3 uses a different scoring method at the root of the tree when the alpha-beta search returns more than one move with the same score. In fact, three different position evaluation functions are used to determine the move chosen at the root for search scores of equal value: one for the opening, another for the middle and another for the end game. These positional evaluation functions use a combination of centre control and mobility — the number of moves available in the given position.

Playing with SC3

The SC3 uses the common algebraic form of chess notation to identify the square from which the piece moves and the square to which the piece moves. Board co-ordinates are always referenced with respect to the human player.

Getting SC3's firmware

Ian Mitchell, author of this article and designer of the SC3 Chess Computer, has generously agreed that *Electronics Australia* can supply the chip programming firmware code as an S19 file, to individual readers who wish to build the project and are able to program their own 68HC705 chips. This file is available for downloading on the EA Reader Information Service BBS, or can alternatively be obtained by sending us a DOS formatted 3.5" or 5.25" diskette, plus $5 to cover copying and return postage. However please note that the complete source code listings and files are only available from the author, for a small fee. The author is also able to program chips for individual constructors, again for a small fee.

The author is also retaining commercial copyright to the SC3 software and firmware, so that kit suppliers and other people who may wish to use the software/firmware in kits or other commercial products will need to negotiate directly with the author. All enquiries should be addressed to Ian Mitchell, PO Box 937, Sandy Bay Tasmania 7006; phone (002) 24 1078.

That is, square A1 is always the square closest to, and to the left of the human player regardless of which colour they are playing.

When the SC3 is first powered up the green LED 'DRAW/LEVEL' (LED 3) will be on and the '1' LED (LED 5) will be flashing. This is the prompt for you to enter the level at which you would prefer the computer to play. Pressing SHIFT (SW1) will cause the '2' LED (LED 6) to flash, indicating level 2. Continuing to press SHIFT will cause the next corresponding LED to flash, and so on until the '1' LED will be flashing again.

After deciding on the level you wish to play, press the 'OK' (SW3) button. The LED indicating which level you have chosen will stop flashing, but remain lit — while the 'FROM/WHITE' LED (LED1) will start flashing. This is the prompt for you to indicate which colour pieces you wish to play. Pressing the SHIFT button at this point will cause the 'TO/BLACK' LED (LED2) to flash, indicating that you wish to play the black pieces. Pressing SHIFT again will cause the 'FROM/WHITE' LED to flash again, and so on. Having decided which colour you would like to play, press OK.

If you have decided to play the white pieces, you can enter your first move now. The 'A' LED (LED13) will be flashing and the '1' and 'FROM/WHITE' LEDs will be lit. To enter, for example, a move from E2 to E4, press the SHIFT button until the 'E' LED is flashing then press NEXT and the E LED will remain lit while the '1' LED will start to flash. Press the SHIFT button until the '4' LED is flashing. You have now entered the *from* part of the move.

To enter the *to* part of the move (E4), press the NEXT button again, and the TO/BLACK LED will light, and then follow the above procedure. If you make a mistake, use the SHIFT and NEXT buttons to correct it.

When you are satisfied that you have correctly entered your move, press OK. If you have not entered a legal chess move the 'FROM/WHITE' and '1' LEDs will light and the 'A' LED will be flashing, indicating that the move just entered is not legal and so you must enter a legal move. If you have entered a legal move, the computer will now calculate its move. During this time the 'MATE' LED will blink once every two seconds to indicate that a move is being calculated.

When the computer has finished calculating its move, the *from* part of the move is displayed on the A-H and 1-8 LEDs and the 'FROM/WHITE' LED will be lit. Press the NEXT button to display the *to* part of the move, and the 'TO/BLACK' LED will light. Pressing NEXT will alternate between displaying the from and to parts of the move. Make the move on the chess board and then press OK.

You are now prompted to enter your next move as before. In general, an LED flashing indicates the group of LEDs to which the SHIFT button can effect.

If you choose to play the black pieces, the computer will be playing white and therefore will calculate and display its move first, as described above.

The computer may enter its low power mode while you are determining your next move. If this happens, all LEDs will be switched off but the state of the game remains intact. To resume where you left off, press the OK button and this will 'wake up' the computer.

If the last move you entered is a winning move (the computer is in check mate) then the 'MATE' LED will light. If the last move calculated by the computer is a winning move (*you* are in check mate) then the move will be displayed as usual and the MATE LED will light as well. If at any point during the game there are no legal moves but neither king is in check, then this is a draw and the 'DRAW' LED will light. Again, pressing OK will begin a new game.

PARTS LIST

Resistors

All SMT:

R1-3	10k
R4	1M
R5-8	220Ω

Capacitors

All SMT:

C1,2	0.1uF
C3,4	22pF

Semiconductors

U1	MC68HC705C8FN, pre-programmed with SC3 firmware
D1	BAS16 SMT diode
LED1-4	3mm green LED
LED5-20	3mm red LED

Miscellaneous

PC board, coded SC3V12; three push-button switches; two 4mm nuts and bolts; one 4.1943MHz crystal; fine tipped soldering iron; fine gauge solder; two 3V batteries; matchbox.

References

Among the many references used by the author in developing this project were the following, which can be recommended for further reading:

How to Beat Your Chess Computer, by Raymond Keene and David Levy, Batsford Ltd.

Computer Games, Vol.1, edited by David Levy. Springer-Verlag, 1988.

How Computers Play Chess, by David Levy and Monty Newborn. Computer Science Press, 1991.

Construction

All of the circuitry for SC3 fits on a PCB measuring only 51 x 32mm, and coded 95cc6. The board is double sided, with plated-through holes, and a small number of surface-mount components are used. The PCB patterns for the board are provided, along with the overlay diagrams to assist in assembly.

It's important to remember that the first component to be mounted on the *top* side of the board must be the 68HC705. I found it easier to solder the surface mount components on the bottom of the board first: C1-C2, R1-R5 and the diode, remembering to observe the correct orientation of the diode. Use a fine tipped soldering iron, with a tip size no greater than one millimetre. Do not attempt any soldering with a larger tip, as solder bridges will be inevitable.

Now the 68HC705 should be mounted on the top side of the board. Because of the 'J' shape of the leads, it may be easiest to pre-tin all of the PCB pads; then place the 68HC705 on the board, observing correct orientation, and while holding firmly, reheat the solder so that it flows onto the pins.

Inspect for bridges

Having soldered all the surface mount components, breath a sigh of relief and do a close inspection to ensure that there are no solder bridges. Next, since the crystal is mounted flat on the top side of the board, bend the leads carefully at 90° to its body, about 1.5mm from the seal. Then bend them again at 90°, level with the side of the body, and cut so that there is just enough length to be soldered. Ensure that the top of the crystal case is clean and pre-tin it with a small amount of solder. When mounting the crystal, solder the top of it to the board so as to ensure mechanical stability.

The LEDs can be mounted next, ensuring correct orientation. Push them all the way down, so that they are flush with the surface of the PCB. It is possible that the edges of some of the LEDs may need to be filed down a little, to ensure correct alignment.

Next mount the three pushbutton switches so that the tops are level with the tops of the LEDs. Some of the pins may be difficult to reach with the soldering iron from the top, assuming the pins do not go all the way through, but it is possible to reach them from underneath. That is, with the soldering iron between the top of the PCB and the bottom of the switch.

Check everything again for solder bridges or misplaced components. If everything looks OK, the batteries can be connected. It's a good idea to place a small piece of sticky tape over the pad closest to the large battery pad negative, to make handling the batteries a little easier. It's also a good idea to put some sticky tape around the edges of the cells so that they are functionally a single 6V battery.

Paper clip bracket

A bracket can be formed from a paper clip or reasonably stiff wire and the batteries bolted to the bottom of the board, with the battery negative making contact with the board and the positive making connection with the bracket. If all is well, LED5 (the '1' LED) should be flashing and LED3 (DRAW/LEVEL) should be lit. If not, disconnect the battery and check everything again.

Check that all the pushbuttons are functioning correctly and that the appropriate LEDs light up. At this point pressing the SHIFT button SW1 should light LED6 and so on until LED5 is again flashing. Press the OK button SW3 and green LED1 (FROM/WHITE) should be lit.

If you are going to mount the SC3 in a matchbox, photocopy the page with the front panel layout, cut it out and stick it to one side of the matchbox.

Next, drill holes for the LEDs and cover the whole box with a piece of clear 'Contact' for protection.

Since there is not enough RAM to record all the moves of the game being played, and because there is no way to take back a move once it has been entered, it is a good idea to record who was playing white, the level chosen for the game and each move as it is made, on a piece of paper. If you find yourself playing a crucial game and a mistake is made, you can always start again — entering the exact same moves as before up to the point where the game was aborted.

If you're with me this far, congratulations. You should now be ready to set up a chess board, and good luck in pitting your skills against SC3! ❖

FORUM

(Continued from page 44)

that the errors may have caused. I believe Mr Ian Hunt VK5QX, of Salisbury East in South Australia, also placed extracts from my letter to Ms Henzell on the packet radio network, with the same idea. My thanks to both of these gentlemen for their courtesy in advising their colleagues of my actions.

In doing so, they along with Mr Bill Roper VK3BR (former Federal Secretary/Manager of the WIA) also served to remind me that most radio amateurs *are* decent, sensible and responsible spectrum users, who don't immediately launch an intemperate personal attack on anyone who is seen to disagree with them.

In short, they reminded me that the much-vaunted 'fraternity' among radio amateurs has not become a myth just yet — despite the actions of a small minority.

And that's where we'll leave this rather sorry tale, I think. I hope you'll join me here in the Forum next month, when hopefully we can discuss something more pleasant. ❖

THE SERVICEMAN

Continued from page 49

soldered. All had been tinned but only lightly crimped.

I had brought my 25 watt 240V soldering iron, but was kicking myself for forgetting the small 300 watt 240V Honda portable genset I usually take for just such jobs. I couldn't solder the lugs directly, as the soldering iron was earthed and battery negative was also earthed. This meant that the pins were live. I jury-rigged the engine to run, then disconnected the batteries. (At this stage the internal 240 volt battery charger wasn't working anyway).

After soldering all the connections, I shut the generator down and reconnected everything. Pressing the local start pushbutton now started and stopped the genset. So far, so good...

I tested the remote start by bridging the contacts leading to it from the circuit board at the generator. This again started and stopped the unit, so I called the owner and asked him to press the button at the house. He did — and nothing happened! I had already tested the remote pushbutton at the house and it was OK, so what was going on? How embarrassing!

Dud cable join

Obviously, there had to be a break in the 150 metres or so of aerial cable from the house to the shed. Following along the cable I spied a join at the highest point (naturally!) and balancing on a ladder, unwrapped it and found it badly corroded. I accidentally bridged the leads together while trying to repair the joint and each time this started the generator. In the end, I disconnected the remote switch at the generator and fixed the connection without further trouble.

After explaining to the owner the problem with the cable, he said that some weeks ago in heavy wind, the generator was starting and stopping by itself during the night! If only I had known that sooner, I could have traced the fault before I embarrassed myself...

Almost finished. The internal battery charger hadn't worked for about 10 years, but I reasoned that it couldn't be all that difficult. I rewired the primary fuse, and turned it on.

Now, a 7.5kVA generator is a powerful brute. Connecting a 2.5kW radiator to it doesn't even cause a hiccup. A 5kW hot water system causes the unit to slow down a small but noticeable amount; but in this case, connecting the battery charger almost stalled the engine!

It turned out that the primary of the charger transformer was a mess of shorted turns. I suggested to the owner that he connect a cheap six amp charger to the batteries, to keep them topped up until I could order another transformer...

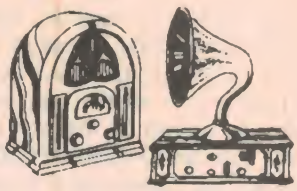
And a final thought on the subject. A strange characteristic of this engine is that it needs 12 volts to open the fuel cutoff solenoid, before it will start. This is OK so long as the batteries can run the starter motor. But to hand crank the engine in an emergency, the fuel solenoid must first be held open with a suitable bolt or nut to weigh it down. It seems to be a poor design, to me.

Thanks for that story, Peter. It's not a bad thing for us city folk to be kept in touch with the problems of providing power to remote properties. There's more to supplying power than just pressing a switch, as your story shows.

Well, that's the end of the car-cum-engine stories for the time being. As I said earlier, there's never been a subject that excited as much interest — but next month we'll be back onto more mundane topics. See you then? ❖

Vintage Radio

by PETER LANKSHEAR



Old power transformers

Last month, we related some experiences in the resurrection of a large 1930 model American Columbia TRF receiver. However, as we ran out of space, the complex subject of dealing with the power transformer had to be carried over until this month. As well as looking at transformer rewinding, we also look at how to work out the voltage and current ratings required.

In the early days of radio, prior to the early 1930's, there were improvements to be made in the design of power transformers. Wire sizes were often a bit on the light side, and insulation (especially enamel) had weaknesses. This was often exacerbated by transformers in American receivers having been designed for 60Hz mains rather than our 50Hz, with the result that there could be 20% less wire and/or steel than conservative operation called for.

Sometimes (and this was quite possibly the case with the Columbia) during attempts to fire up a receiver, the 240 volt mains may have been connected to a transformer intended for 110 volts. Whatever the cause, the evidence of melted pitch around the Columbia's transformer case was sufficient warning that it was highly likely a rewind would be necessary.

Why were the old transformers subjected to the messy business of being buried in a box of pitch anyway? This practice was not confined to power transformers either. Frequently chokes, audio transformers and capacitors were treated similarly.

The major reason was protection from moisture — but filling of chokes and power transformers has another benefit. Unless core laminations are very tightly clamped, there is a chance that they will hum and buzz, and in some cases can be very hard to silence. Encasing in pitch will silence practically any laminated core.

A suitable sealant must have a reasonably high melting point, be non hygroscopic and inexpensive. Also it must flow easily, so as not to leave voids during filling. Although not a very attractive material, pitch meets these requirements quite well. In more recent times, it was common for professional grade transformers to be potted in a pitch based compound. Today, other materials such as potting resins are used as well.

Difficulties

Whatever its virtues, when it comes to dealing with a transformer that has failed, pitch can be a frustrating 'pain' to deal with. Not only can it be messy, but the very properties that make it such a good potting material also make it hard to remove from a can.

In the past, many servicemen have understandably sidestepped the problem by simply substituting a stock replacement transformer and throwing away the original — thereby leaving a problem for the restorer who demands authenticity. Similarly, a rewinder can hardly be blamed if he declines to rewind a transformer embedded in a black gooey mess! Some transformer rewinders do have access to Trichloroethylene vats or the like, but most are likely to appreciate and charge correspondingly less if they do not have to perform the chore of cleaning out the pitch first.

Fig.1: As well as being somewhat antisocial, using the kitchen oven for exposing a pitch encapsulated transformer is not completely effective. There is still a tenacious coating which is very resistant to mechanical removal.

Therefore, a transformer in need of a rewind may well have to be unpotted by you. But to try and simply dig the windings out of the can at room temperature is a hopeless proposition.

One method is to arrange for the family cook to go on holiday for a couple of days and, when the coast is clear, the transformer is suspended for a few hours over a suitable container in the kitchen oven, heated to a moderate temperature. This will melt out the pitch, but unless there is an efficient ventilating fan in the kitchen, the smell can linger for a long time — and bitumen is not flavour of the month in most households. Furthermore, the transformer is likely to be left with a tacky black coating, typical of that in Fig.1.

There is a better way. When very cold, most grades of pitch become brittle, with a consistency much like that of coal. The cases of most filled transformers have one side that is either open or removable. This should be removed and the transformer put in the coldest part of a deep freezer for a few hours. The pitch may then have shrunk sufficiently to allow the contents to slide out of the can.

In any event, unless it is a very soft grade, the pitch, will be sufficiently brittle to crumble readily with a few taps of a piece of wood or a hammer, exposing a relatively clean winding as shown by the example in Fig.2. Any remaining traces of pitch can be cleaned off with a petrol soaked rag. Save the pitch, as it will be needed later. The transformer can now be packed off to your favourite rewinder. Don't forget to include as much information as possible.

For rewinders

This next section is directed mainly to readers who are prepared to tackle, or are involved in transformer winding. To determine the specifications for a new winding, the conventional approach is to count the turns and measure the gauges of the wires originally used.

For a proven design of transformer that failed due to external causes this is the correct method; but as pointed out previously, American transformers were frequently designed for 60Hz mains supplies, and often had 110V primaries which, for convenience in Australasian conditions, may as well be replaced by a 230/240V winding.

Transformer design is quite complex, but for satisfactory operation there must be sufficient steel in the core and turns of wire in the windings or the transformer will be inefficient and overheat. One vital parameter governing the number of turns is the magnetic characteristics of the steel, but this will generally not be available. Fortunately a rule of thumb has been worked out that has proved satisfactory for most old cores.

Area of core

The critical parameter is not the total amount of steel in the core, but rather the cross-sectional area of the centre leg which determines the number of turns per volt. It has been found that for a transformer with the type of steel used in old power transformers, and operating at 50Hz, with one square inch of core cross sectional area, eight turns per volt is satisfactory. (This allows for the thickness of the insulation on the laminations etc., and I have used imperial measurements as these were usedinmostoldtransformers).

The formula is simply to multiply the voltage of the winding by eight and divide the result by the core area in square inches. For example, a typical old core with a centre leg of 2.0 square inches, should have windings with a minimum of four turns per volt.

Therefore a quick check is to count the number of turns on one of the old windings — say for example the 5.0 volt rectifier filament winding, and use the formula (turns on winding/winding voltage) x area of core in square inches. If the result is less than eight, it would be advisable to increase the number of turns in the new windings. In most cases, especially when using modern insulation, this will not be a problem as the older cores usually had plenty of window space.

A weakness of these old transformers can be that of undersized wire for filament windings. However, advantage can be taken of the fact that many used cotton-covered wire, and larger diameter enamelled wire can be used for the replacement winding occupying the same space.

With the transformer rewound and reassembled, and ready to be put back into service, it is very tempting to wedge it into its box without the hassles of replacing the pitch; but unfortunately, to do so is inviting trouble.

Enclosing a transformer in a relatively airtight box will cause overheating. Air is a very poor conductor of heat, and consequently air cooling of transformers is dependent on free and rapid air circulation. Pitch is a much better heat conductor than air, and readily transfers heat to the surface of a case where it can be dissipated.

Fig.2: The same transformer after a spell in a deep freeze. A few taps with a hammer shattered the brittle coating and the residue was cleaned off with a petrol soaked cloth.

Refilling essential

If the original transformer case is to be retained, there is therefore no option but to refill it with pitch. This can be quite easy. The melting point varies, but is somewhere in the region 100 - 150°. A large tinned fruit can is a suitable container and any reasonable source of heat, including a gas barbecue can be used. For my own workshop I picked up for a few dollars a small used table-top electric cooker, with a six inch hot plate and simmerstat control. The same safety precautions should be taken as with hot cooking oil, and be careful not to overheat the pitch, or there could be damage to the transformer windings. Use only sufficient heat for it to flow readily.

Extra pitch is likely to be needed to replace inevitable wastage. One source of supply would be roofing contractors, but some time ago I obtained sufficient to last me a lifetime by asking at the local Municipal Electricity Department store for some of the compound used in underground cable boxes. I was given a two gallon tin of what is really highly refined pitch, perfect for the job.

What voltage?

Last month, I promised to explain how I determined the HT voltage for the rewound power transformer of the Columbia receiver. While experienced vintage enthusiasts will be familiar with the procedures involved in calculating the operating conditions of receivers, newcomers may be interested in the methods that I used.

Radio manufacturers were generally very coy about publishing the HT winding voltages of receiver power transformers. There are several likely reasons. One was that 60 years ago, few servicemen were equipped to measure high AC voltages accurately. Another was that in the highly competitive radio industry, design knowledge was valuable, and therefore such information was what we today call 'commercially sensitive' — referred to then as 'trade secrets'.

Many circuits did provide valve pin voltages other than for the rectifier, and these are usually sufficient to base calculations on. However, in the case of the Columbia receiver, the circuit provides no voltage clues at all and some assumptions will have to be made. For easy referral the circuit has again been printed.

The first step is to estimate the likely main HT voltage. Fortunately, it is not at all critical and approximations are quite sufficient. As the output stage valves normally have the highest voltages, in this receiver the HT supply to the anodes of the 45's is a good place to start. Reference to early RIA tube manuals which provide comprehensive data for these valves shows their maximum anode voltage is 275 volts, and give details

for operation at 250 volts. There is little merit in operating old valves at maximum ratings, and an analysis of a number of circuits indicates that a majority of designers settled for 250 volts.

The anode or plate voltage ratings of valves refers to the anode to cathode potential, NOT anode to earth. In the Columbia, as was the usual method, grid bias for the output valves is derived from the anode current voltage drop through an 800 ohm resistor between the filaments and earth, and is given by the Manual as 50 volts. This voltage, plus the drop in the output transformer, must be added to the anode voltage to arrive at the HT figure.

The anode current of 62.5mA for a pair of new type '45 valves can be calculated by the simple formula Bias Volts/Bias Resistor, or 50/800 = 0.0625. Assuming that the valves are not brand new, a current of 30mA each is quite close enough.

The resistance of each half of the output transformer was measured at about 300 ohms, so that the voltage drop in each side would be about 10 volts. Thus the main HT at point (A) should be 310 volts.

RF stage operation

The next step is to estimate the proposed operating conditions for the RF stages. Their voltages are set by the voltage divider formed by the 3000 ohm speaker field and the two 1500 ohm resistors.

Note that in these early sets, the speaker field did not double as a filter choke as became later standard practice. The total resistance of the network of the speaker field and the 1500 ohm resistors is 6000 ohms, permitting a current flow with 310 volts applied of approximately 50mA, which would be a reasonable amount of excitation for a speaker of this type.

However, the current taken by the RF amplifiers must be taken into account. To achieve absolute accuracy, this becomes quite complex as the valves themselves constitute a dynamic load. We have a roundabout wherein the current drawn is dependent on screen voltage, which in turn is dependent on the current through the voltage divider and the volume control setting — varying from practically zero to 10mA or so.

The mathematics involved would be a candidate for one of Peter Phillips' 'What??' puzzles.

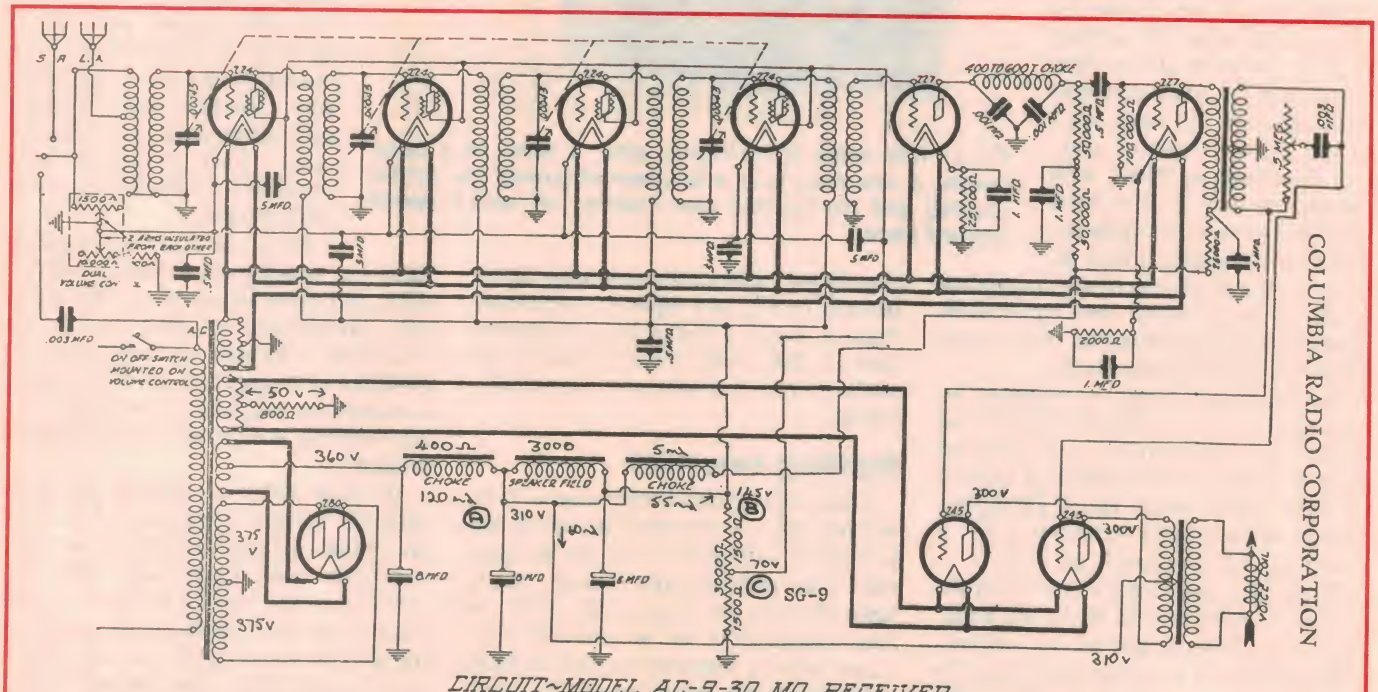
Fortunately in practice, and because of other factors such as valve ageing, varying mains voltages, and component tolerances, extreme precision becomes academic. In any event, the heavy current through the speaker field and dividing resistors will have a considerable stabilising effect.

Assuming therefore, that the current for the RF stages under typical operation is 5mA, the total current through the speaker field will be 55mA. Added to this is the 60mA for the output stage and a nominal 5mA for the detector and audio valves, to give a total HT current of 120mA.

The voltage drop through the speaker field will be .055 x 3000 = 165 volts, giving a voltage at (B) for the anodes of the RF stages of 310 - 165 = 145 volts. It then follows that as the screens are fed from point (C), which is conveniently half way between the anode supply point and earth, they should have a potential of about 145/2 or about 70 volts.

At full volume, with the extra current drain, these voltages would fall slightly to be very close to the traditional 135 volts HT and 67 volts for the screens — figures very commonly specified for battery powered receivers. This could be taken as confirmation that the voltages chosen are close. Although 24A's can be operated at higher voltages, it is unlikely that four cascaded stages would remain stable if run at full ratings, and it is likely therefore that our estimated conditions are correct.

In any event, receivers are rarely dependent on precise operating voltages and the heavy current through the voltage divider masks the variations in the currents drawn by the valves. For critical situations, gaseous regulators were used to stabilise voltages, but these were rarely used in domestic radios.



CIRCUIT~MODEL AC-9-30 MQ RECEIVER

Here again is the circuit of the Columbia SG-9/AC-9-30, but with the addition of the estimated voltages and currents, and the resistances of the components involved.

WINDING TEMPERATURE

The operating temperature of transformer windings is important as it affects reliability and safety. With standard class A insulating materials, the maximum allowable temperature at any point is 105° C. Allowing for various factors, the maximum temperature rise above ambient in a winding should not be more than 45° C.

With exposed cores, the time honoured rough and ready test is that if a hand can be held on the core comfortably for 5 seconds, the temperature is satisfactory, but how can a potted transformer be checked? The fourth edition of the Radiotron Designer's Handbook in Chapter 5, Section 5 (v) describes a simple method of finding the temperature rise by comparing the cold and hot resistances of the winding. Based on the temperature coefficient of copper of 0.00393 the change of resistance can be calculated using the formula.

$$\text{Temperature Rise} = \frac{R_{hot} - R_{cold}}{R_{cold} \times 0.00393}$$

A correction should be made for any change in ambient temperature during the test.

As a practical example, the primary of a Majestic 90B pitch encapsulated power transformer was tested. During a 5 hour run, the resistance rose from 10.1 Ω to 11.3 Ω, while the ambient temperature rose by 7° C.

$$\text{Temperature Rise} = \frac{11.3 - 10.1}{10.1 \times 0.00393} = \frac{1.2}{0.03969} = 30.23°$$

Subtracting the rise in ambient temperature, the operational rise was therefore ; 30.23° - 7° = 23.23°.

As this is well below a rise of 45°, the transformer in this example is quite satisfactory.

While touch is a commonly used gauge of temperature, it is not very accurate, and is obviously of little use for potted transformers. Here is a simple and more precise method which can be used for any winding on any transformer.

Transformer voltages

We are now at the stage where the voltage and current at the output of the filter choke is 310 volts at 120mA. The voltage drop in the filter choke is the next calculation. As its resistance is 400 ohms, the voltage drop is simply the current by the resistance; 0.12 x 400 = 48 volts, or 50 volts in round figures. This is added to the 310 volts at the input to the speaker field to arrive at a figure of 360 volts across the first filter capacitor.

Now, at last, it is possible to determine the transformer HT winding. Referring to the Tube Data book again, and by reading off the graph for a capacitor input filter for the type 80 rectifier, we find that for an output of 360 volts at 120mA the input to each of the rectifier anodes should be 375 volts. The HT winding specification is therefore 2 x 375 = 750 volts centre tapped, at 120mA into a capacitor input filter.

The specification for the filament windings is simply a matter of adding up the individual currents. The main filament winding supplies two type 27 and four type 24A, each 2.5 volts at 1.75 amperes or 10.5 amperes total! The winding for the output stage feeds two type 45 valves, each requiring 2.5 volts at 1.5A. Finally, the rectifier filament winding for a single 80 is 5.0 volts at 2A.

The transformer was duly rewound to these specifications, with a gauge heavier wire than used originally, but with a 240 volt primary to suit local conditions. As always, it seemed a bit of a desecration to bury it in molten pitch, but as we have seen, there was no real alternative.

With the transformer installed, the receiver was fired up, and the various voltages measured. They all proved to be very close to the calculated values, and the receiver is performing well.

One of the great satisfactions of vintage radio restoration is to have a major project like this work out as intended. Somehow, filling a printed circuit board with solid state components just isn't the same!

There is still a lot that can be written about transformers and power supplies, but as space has once more run out, we will have to continue in the not too distant future. ❖

NOTES & ERRATA

NEW BOOKS (May 1995): In the review of the Comprehensive Radio Valve Guide, Books 1 -5, published by G.C. Arnold Partners, we inadvertently gave an incorrect telephone and fax number for ordering the books directly from the publisher. The correct number is +44 1202 658474, and the full address is 9 Wetherby Close, Broadstone, Dorset BH18 8JB, England.

EA READER INFORMATION SERVICE BBS: Bob Barnes, of RCS Radio has created and generously contributed a library of circuit schematic symbols which allows convenient use of Protel's freeware PCB drawing package EASYTRAX for drawing schematic diagrams as well. You'll find the library, together with its documentation and a 'PCB' file showing the symbols in A4 chart form, on the BBS in the Technical Software file area, as a compressed file named EZSCHEM1.ZIP.

JUNE BARGAINS FROM JAYCAR

Jaycar Vifa

AS REVIEWED IN ELECTRONICS AUSTRALIA JUNE 1995

JV80 8" SUBWOOFER

The driver used in this subwoofer is the fabulous new Vifa M22WR 8" driver. It incorporates a long stroke, low reflection magnesium basket, has a 50mm voice coil and a very stiff conical paper cone with a low damping rubber surround. Power handling is an amazing 150WRMS. Please contact us for a copy of the article from Electronics Australia if you don't have it.

The cabinet is supplied prebuilt and is made from MDF in blackwood veneer. Grill is supplied with speaker cloth mounted. Cabinet size is very small, with a volume of 35 litres, and measures 600 x 270 x 300mm. We recommend a polyswitch speaker protector to help protect the driver.

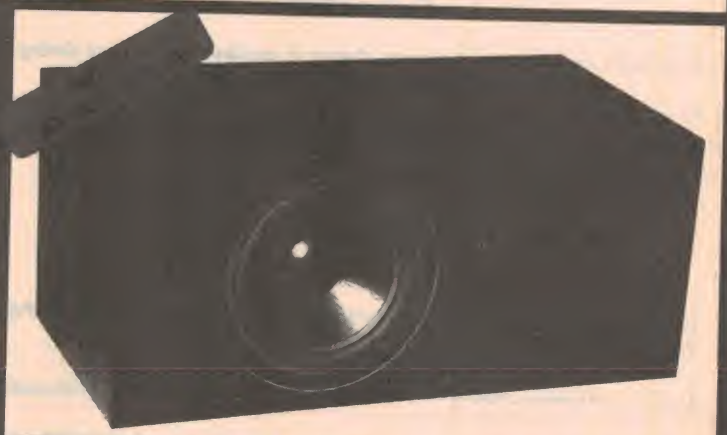
NEW

Check with your local Jaycar store for a demo. Demos in most stores.

Speaker - Vifa M22WR Cat CW-2115	$199.50
Polyswitch Cat. RN-3472	$10.95
Cabinet Cat. CS-2540	$139.00
	Total $349.45

Quote from Rob Evans in Electronics Australia Magazine.

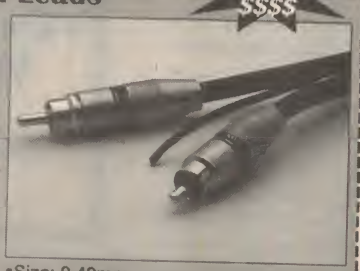
"The JV80 performed extremely well in both our subjective and objective tests, and really did demonstrate how a refined driver such as the Vifa M22WR can deliver the goods in a correctly tuned enclosure".



Save On Professional Quality OFC Reference Series RCA Leads

SAVE $$$$

These Reference Series use OFC shielded low capacitance cable with a central lead wire for remote switching of car amps, or for extra grounding on home Hi Fi. Cable is figure 8 OFC blue colour with an OD of 5mm per side. Plugs are superb quality gold with nickel metal covers. Each lead is colour coded with red and black RCA plugs. Each lead has two RCA plugs on each end.



Specifications:

- Material: Oxygen Free Copper
- Stranding: 10/0.12mm
- Shield type: Spiral
- Ground wire: 10/0.12mm
- Capacitance: 68.8PF/M
- Size: 0.40mm
- Diameter: 0.75mm
- Standard: 45/0.12mm
- Resistance: 0.0385Ω/M
- Impedance: 65Ω at 1MHz

0.5 metres	was $19.95	June $14.95	Save $5	Cat WA-1060
1.5 metres	was $24.95	June $18.95	Save $6	Cat WA-1062
5.0 metres	was $34.95	June $27.95	Save $7	Cat WA-1066

64K DATABANK

NOW IN STOCK

Features: •64K memory •Databank •Real time clock •Calendar •Calculator •Currency conversion •Data communication available plus more. See our 1995 catalogue page 183 for further details. Smaller models also available.

Cat. QM-7320 **$129.50**

PC INTERFACE

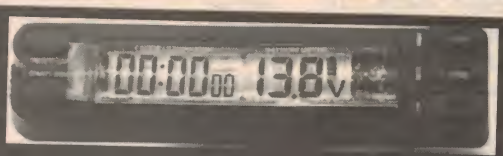
Cat. QM-7324 **$39.50**

PRO RACK CASE SELLOUT

Save money on our grey professional rack cases. See our 1995 catalogue page 121 for full details.

	Cat No.	Was	Now	Save
1 unit	HB-5120	$75.00	$59.00	$16.00
2 unit	HB-5125	$99.50	$79.50	$20.00
3 unit	HB-5130	$109.50	$89.50	$20.00

CAR VOLTAGE METER / CLOCK / STOPWATCH



NEW

Features: •Automatic 12/24V selection •Digital readout for battery voltage •Lap counting •Stopwatch for sports •Digital clock 12/24 hour selectable •Backlit •Small size 115(W) x 27(H) x 15(D)mm

Cat. XC-0118 **Only $29.95**

SAVE ON BENCH ENCLOSURE

See our 1995 catalogue page 120.
Size 132(H) x 279(D) x 304(W)mm

Cat. HB-5570 **was $59.95**

NOW $44.95

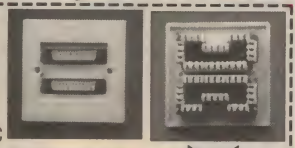
SAVE $15.00

ABS PLASTIC BOX

Made in the U.K. from ABS. Has a precision fitting moulded lid with metal bushes to take countersunk screws (supplied). Its about the same size as the largest size Jiffy Box. Measures 190(L) x 110(W) x 60(D)mm. Jiffy box sells for $6.75.
BUY THESE FOR ONLY $3.95 EACH.
Normally sells for around $12. Colours available: white, blue and orange.

Cat. HB-5504 **Only $3.95 ea**

D-SUB SPEED CONNECT DATA PORT



Another surplus buy. Made in the U.K. These ports provide the user/installer with a simple system for installation of "D" connectors. The IDC feature eliminates soldering, and wires can be quickly disconnected and rewired to new pins if required. Inserting wires is made easier if you have a BT inserter tool. Faceplate is UK power point size ie 85 x 85mm - white in colour. Fitted with 2 x D25 females. LIMITED QUANTITY AVAILABLE.

NEW

Cat. PP-0859 **only $5 ea**

Save $30 On Car Speaker Kit

The system consists of 6.5" woofer, and a Neodidyium Super Tweeter with a high power crossover. They handle high power, so require a power amp of at least 30WRMS per channel to drive them properly. 10 watts is not enough!
SPECIFICATIONS:
•Power handling - 80WRMS/240W PMPO •Impedance - 4 ohms •Freq resp - 50 to 22,000Hz •Sensitivity: 90dB 1 watt 1 metre •Resonant frequency (fs): 50Hz •Sound pressure level - 90dB •Woofer - 6.5" with treated paper cone and rubber surround, magnet weight - 10 ounce, voice coil dia 25mm •Tweeter - Super tweeter with surface mount design. Small size with great response •Crossovers - High power units with crossover frequency of 2500Hz. Each housed in its own case.
Supplied with metal grills for woofer and mounting screws/cables etc. A quality set of speakers that will give you years of excellent service. Add to this a Subwoofer for excellent car Hi Fi sound.

Cat CS-2275 was $199.50 pr **JUNE $169.50 PR**

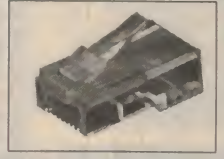
75Ω WALL SOCKET PLATE BARGAIN

NEW

These have a standard 75 ohm socket in the centre of a square plate. They are not the standard power point size, but they are cheap!
Plate size: 85 x 85mm. Colour white.

Cat. LT-3028 **only $2 ea**

TELEPHONE PLUG 8/8 RJ45 SPECIAL

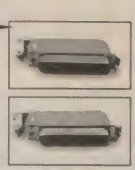


ATTENTION COMPUTER INSTALLERS
These are NOT AUSTEL APPROVED. We are selling these in bags of 50 pieces. Save a fortune over normal prices.
NORMALLY AROUND $1.00 EACH

NEW

Cat. PP-1436 **$17.95 pkt 50**

50 PIN CENTRONICS/SCSI CONNECTORS



NEW

Right angle entry, complete with metal backshells.

Cat. PP-0891 Male **$3.95**
Cat. PS-0899 Female **$3.95**

BUY 10 LESS 10%

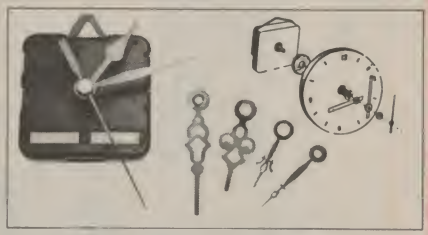
Save On Interlocking Parts Drawers

Unique side and top/bottom keying system allows you to use just a few or build a whole wall of drawers as your parts expansion dictates. Quality designed drawer slides will not 'stick' or seize. Slide handles also takes identity cards. Single or double drawers available.
Size: 110(W) x 120(D) x 50(H)mm

SINGLE DRAWER Cat. HB-6300
Normally **$5.95**
JUNE $4.75 or 10 FOR $40

DUAL DRAWER Cat. HB-6301
Normally **$6.20** **JUNE $5.00 or 10 for $45**

Clock Movement



•Very compact 56 x 56 x 15mm •Self starting one second stepping motor •Uses 1 x AA battery that lasts 1 year •±15 second/month accuracy •Supplied with three sets of hands •Includes sweep second hand

Cat. XC-0100 **only $9.95**

300VAC VARISTOR BARGAIN

Specifications: •Dia: 7mm
•RMS Volts: 300 •DCV: 405
•Joule: 25 •Peak Current: 1200A
•Capacitance: 70pf

NEW

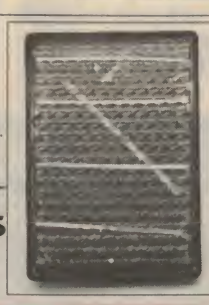
Cat. RN-3402 **$1.50**

Tamper Proof Torx Screw Bit Set

The set consists of 7 Tamper Proof Star pieces which fit the 6 point STAR type screws with tamper proof pins, as those found on computer systems etc. They are T10, T15, T20, T25, T27, T30, T40. Made from chrome vanadium - steel and heat treated.

Cat. TD-2034 **$14.95**

0.45 VOLT 1000MA SOLAR CELL SPECIAL



Ideal for experimentors. Connect in series or parallel. Terminal strap enables easy connection to other cells.

Cat. ZM-9004
normally $7.50

SAVE

JUNE ONLY $4.95
SAVE $2.55

2 FREE PROBES WITH 25MHZ CRO PURCHASE

The Jaycar 25mHz Dual Trace CRO features delayed sweep. Most other CROs are 20mHz, our is 25mHz. See 1995 catalogue page 35 for details and specifications.

Cat. QC-1900 only $749

June - 2 probes supplied free, value $79

JAYCAR SELLS FOR LESS COMPARE OUR PRICES

LATEST JAYCAR KITS

Playmaster 300W Subwoofer Amp Kit

NEW

REF: ELECTRONICS AUST APRIL / MAY 1995

Cat. KA-1770

$349

Mini Spot AM/FM Alignment - Source Kit

NEW

REF: EA 4/95

This kit will provide both a 455kHz signal for aligning AM radio IF strips and a 10.7MHz signal for doing the same job on FM radios. Both signals are modulated with an audio tone of around 1kHz, with the 1kHz audio signal available by itself for audio testing. The Jaycar kit is complete with PCB, case, silk screened front panel, plus all electronic components. Three AA penlight batteries required. Use Cat. SB-2354 Pk4

Cat. KA-1796 **$23.95**

Digital Trigger Adaptor Kit For CRO's

NEW

REF: EA 4/95

This project allows you to use your CRO more effectively with digital circuits by allowing you to monitor any given event in the circuit under test, and to trigger the scope only when all the relevant input conditions are met. With eight inputs (expandable to 24), it also includes an adjustable trigger delay, so it can effectively convert your scope into a low cost logic analyser. Kit is complete with PCB, case, screen printed front panel, IC test clips plus all electronic components.

Cat. KA-1772 **$55.00**

Dolby Pro Logic Surround Sound Kit

REF: SILICON CHIP DEC 94 / JAN 95

DOLBY SURROUND PRO • LOGIC

Short Form Kit

This kit is supplied with pre-tinned PCB, Dolby ICs and all electronic components as per the Silicon Chip article, RCA socket bank, potentiometers, switches and internal audio and mains cable. The short form version of the kit is ideal for those constructors who wish to build a complete decoder with amplifier modules in the same case as the decoder.

EXCLUSIVE TO JAYCAR.

Cat. KC-5175 **$169.50**

Enclosure Kit

This includes the low radiation toroidal transformer, mains lead and plug, fuse holder and fuse, mains switch, black anodised brushed aluminium instrument knobs, professionally punched and screened front panel, punched rear panel plus all mounting hardware.

Cat. KC-5176 **$69.50**

Economy Surround Sound Decoder Kit

NEW

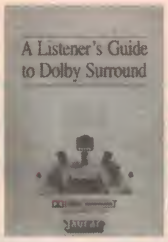
REF: EA 5/95

This surround decoder uses low distortion analogue circuitry to produce a surround channel, centre channel and subwoofer output channel. If our genuine Dolby Pro-Logic decoder (KC5175) is out of your price range, then this economy decoder is worth considering. The Jaycar kit is 100% complete with case, PCB, punched & silkscreened front panel, punched rear panel, transformer, RCA sockets plus all elec components as per the EA article.

Cat. KA-1773 **$59.50**

A Listeners Guide To Dolby Surround Book

NEW



If you are planning a home theatre for your home, then this guide is essential. It covers all aspects of what you need to set up, and get the most out of a home theatre system. Topics covered: •Speaker placement •Subwoofers •Surround and centre channel speakers •Power amplifiers •Enhancements for movie viewing - plus much more! This book will answer virtually any question you may have regarding Pro Logic Surround Sound. Don't be left behind - the home theatre revolution is here! 11 pages with fully illustrated pictures Size: 210mm x 295mm.

Cat. BC-1200 **only $2.95**

Low Cost Temperature Controlled Soldering Iron

Ideal hobbyist soldering station. It operates on 240 volts, and the transformer delivers a safe 16 volts to the soldering iron. It has a PTC (Positive Temperature Coefficient) soldering tip at a constant temperature of 310°C which is ideal for PC work. It has a 20 second heatup time. Replacement Tip Cat TS1202 $9.95

SAVE $14.95

Cat. TS-1200

WAS $49.95 NOW $35.00

JayTech ALARM PANELS

4500 4 SECTOR PANEL

Cat. LA-5420

$109.50

6000 6 SECTOR PANEL

Cat. LA-5430

$139.50

•Programmable •24 hour tampers •walk tests •intelligent auto rearm •plus more

See our 1995 catalogue for full details

JAYCAR WILL NOT BE UNDERSOLD ON PRODUCTS OF THE SAME QUALITY

D41264C-15 RAM

NEC BRAND - LIMITED QTY AVAILABLE

Cat. ZZ-8520 **only $8.95 ea**

Jaycar RESPONSE

WOOFERS / SUB WOOFERS

See our 1995 catalogue, or call for full details. Now available with single voice coils. All these drivers have 8 ohm voice coils and have rubber surrounds and huge magnets. Two ranges available, one with polypropylene cones, and the other with carbon fibre cone.

ALL THESE DRIVERS ARE ALSO AVAILABLE IN 4Ω IMPEDANCE. SEE OUR 1995 CAT

Size Inch	Cone Material	Power Handling	Box Size Vented	Box Size Sealed	Cat No.	Price Each
6"	Polycone	80RMS	26LT	10LT	CW-2135	$55.00
6"	Carbon Fibre	80RMS	24LT	15LT	CW-2140	$79.50
8"	Polycone	120RMS	33LT	27LT	CW-2136	$69.50
8"	Carbon Fibre	120RMS	25LT	20LT	CW-2142	$115.00
10"	Polycone	160RMS	50LT	32LT	CW-2137	$109.50
10"	Carbon Fibre	160RMS	65LT	33LT	CW-2143	$169.50
12"	Polycone	200RMS	120LT	80LT	CW-2138	$149.50
12"	Carbon Fibre	200RMS	116LT	76LT	CW-2145	$209.00

DUKE SPEAKER KITS SLASHED

See 1995 catalogue page 47

DK77 SPEAKER KIT

Features 2 x 6" woofers, dome mid and dome tweeter. Power handling 120WRMS

SPEAKER KIT (PR) Cat. CS-2530
WAS $399PR NOW $299PR
SAVE $100

DK77 CABINET Cat. CS-2532
WAS $290 PR NOW $250PR
SAVE $40

DK11 SPEAKER KIT

6" bass and dome tweeter. Power handling 60WRMS

SPEAKER KIT (PR)
Cat. CS-2520
WAS $229PR

SAVE $ $ $

NOW $159PR
SAVE $70

CABINETS TO SUIT DK11
Cat. CS-2522
WAS $170PR
NOW $140PR
SAVE $30

NEW LOWER PRICES

PLASTIC "LINE TYPE" CASE

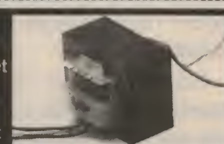
NEW

This case is new, but contains components which were removed. It consists of two halves of hard and high impact plastic held together by 4 self tapping screws. The box measures 88L x 68W x 55Dmm. In the middle of each lid is a small rectangular hole measuring 10 x 7mm. It is ideal for an in-line power supply or some sort of interface. It is well made and quite rigid. It would also make a cheap general purpose small enclosure. A redundant manufacturers identification panel appears on one side of the case. Even a low cost jiffy case of similar size would cost about $3.00. This box is better quality at half the price.

1-4	$1.50 ea
5-9	$1.35 ea
10+	$1.20 ea

Cat. HB-6080 A great buy for the junk bin

CHEAP 12V POWER



The more power you need, the more you save! Yes, yet another massive scoop purchase. This time its a 240V to 2 x 12VAC (at 1 amp) chassis type tranny. We say chassis type, but the tranny itself has no strap bracket like our standard chassis-mount unit. You can make a strap bracket for these out of a jiffy box lid or, as many do nowadays simply hold it down with a couple of medium cable ties. If you don't have a problem with the mounting you will save a fortune! Normally, you would expect to pay about $16 for a 2 x 12VAC 1A tranny BUT NOT THIS TIME!!! We have a fairly solid quantity of these little beauties and we are keen to sell!! Our price is therefore reflected in the quantity you buy. Each tranny has primary and secondary leads abot 300mm long and are colour coded. Great for +/-12V DC supplies 12V at 2A etc. Grab a few for the parts box!

NEW

1-4	$5.00 ea
5-9	$4.25 ea
10-25	$3.95 ea
25-99	$3.65 ea
100+	$3.50 ea

Cat. MM-2000

TRULY A BARGAIN

Jaycar ELECTRONICS

HEAD OFFICE	WHOLESALE	MAIL ORDERS	MAIL ORDER - PHONE	POST & PACKING
6 LEEDS ST RHODES 2138	PHONE: (02) 743 5222	PO BOX 185 CONCORD 2137	FREE CALL - ORDERS ONLY	$10 - $24.99 $ 4.00
PHONE: (02) 743 5222	ORDERS: 1800 620 169	ROAD FREIGHT ANYWHERE	(008) 022 888	$25 - $49.99 $ 5.00
FAX: (02) 743 2066	FAX: (02) 743 3070	IN AUST (up to 20kg) $14.00	HOTLINE (02) 743 6144	$50 - $99.99 $ 7.00
				OVER $100 $ 8.00

MasterCard · AMERICAN EXPRESS Cards Welcome · VISA

ADELAIDE SA •194 Wright St (Cnr. Selby St)•Ph:(08) 231 7355 •Fax:(08) 231 7314•Mon/Fri:9-5.30•Fri:8.30•Sat:9-12pm

BURANDA QLD •144 Logan Rd•Ph:(07) 393 0777•Fax:(07) 393 0045 •Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4pm

CANBERRA ACT •11 Kembla St. Fyshwick•Ph:(06) 239 1801 •Fax:(06) 239 1821•Mon/Fri:9-5.30•Sat:9-1pm

COBURG VIC •266 Sydney Rd•Ph:(03) 384 1811•Fax:(03) 384 0061 •Mon/Fri:9-5.30•Fri:8.30•Sat:9-4pm

MELBOURNE CITY •Shop 2, 45 A'Beckett St•Ph:(03) 663 2030•Fax:663 1198 •Mon/Fri:9-5.30•Fri:8.30•Sat:9-2•Sun:10-4pm

SPRINGVALE VIC •887-889 Springvale Rd Mulgrave. Nr Cnr. Dandenong Rd •Ph:(03) 547 1022•Fax:(03) 547 1046 •Mon/Fri:9-5.30•Fri:8.30•Sat:9-4pm

SYDNEY CITY •129 York St•Ph:(02) 267 1614•Fax:(02) 267 1951 •Mon/Fri:8.30-6pm•Thurs:8.30pm•Sat:9-4pm

BANKSTOWN •363 Hume Hwy Cnr Meredith St•Ph:(02) 709 2822•Fax:(02)709 2007•Mon/Fri:9-5.30•Thurs:8.30pm•Sat:9-4•Sun:10-4pm

GORE HILL •188 Pacific Hwy (Cnr. Bellevue Ave)•Ph:(02) 439 4799•Fax:(02) 439 4895•Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4•Sun:10-4

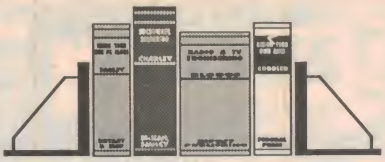
NEWCASTLE •830 Hunter St.•Ph:(049) 653 799 •Fax:(049) 653 796 •Mon/Fri:9-5.30 •Sat:9-4pm

PARRAMATTA •355 Church St (Cnr. Victoria Rd)•Ph:(02) 683 3377 •Fax:(02) 683 3628•Mon/Fri:9-5.30•Thurs:8.30pm•Sat:9-4pm •Sun:10am-4pm

PENRITH •199 High St•Ph:(047) 21 8337•Fax:(047) 21 8935 •Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4pm•Sun:10-4pm

RHODES •6 Leeds St•Ph:(02) 743 5222•Fax:(02) 743 2066 •Mon/Fri:9-5.30

NEW BOOKS



Fault libraries

TV FAULTS and VIDEO FAULTS, Sixth Editions 1995, published by Technical Applications. Plastic comb binding, 300 x 210mm, 218 pages and 196 pages respectively. Both fault libraries available alternatively as database files on an IBM-compatible floppy disk, along with a program and also a camera/monitor database. Printed libraries $90 each or $165 per pair, or $160 on floppy disk, including postage anywhere in Australia.

The lot of domestic electronics service technicians is getting harder and harder all the time, with equipment not only getting more complex and sophisticated, but also more reliable — so that you tend to have less opportunity to become familiar with both the gear and its faults. Not only that, but customers are nowadays much less happy than in the past about paying for what is inevitably a labour-intensive activity, especially if their TV or video is a few years old and lacks some of the 'bells and whistles' of the latest models...

Small wonder, then, that more and more technicians seem to be turning to the use of compiled 'fault lists' or databases, as an aid to finding faults faster and more efficiently. While such lists won't always provide the exact cause of a particular fault, they can at least help you quickly rule out the more common causes, leaving more time to track down an unusual and hard to find fault.

Keith Jakins, the proprietor of Queensland firm Technical Applications, has been compiling and supplying his valuable TV and Video fault libraries for some years now, and has just released them in these updated sixth editions. Together they now cover over 10,000 different faults, in models widely sold in Australia.

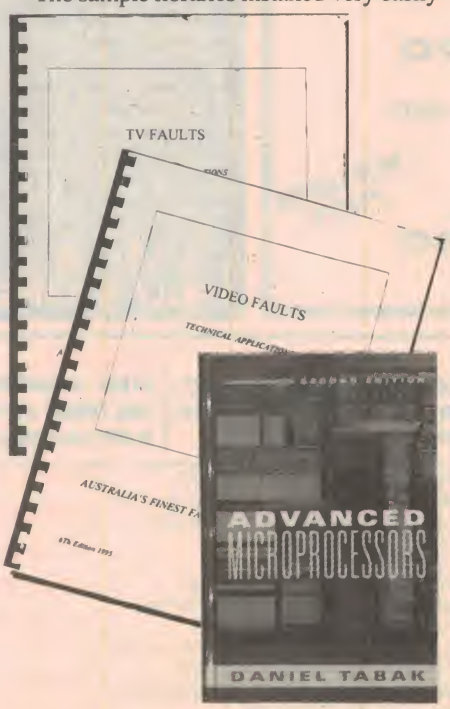
Not only that, but each fault library comes with an accompanying and very useful model cross-reference list, to allow identification of the models (often quite a few of them) which either share virtually the same chassis, or differ in only minor respects. The cross-reference list in the TV Fault library is 25 pages long, while that in the Video Fault library is six pages long.

Both main fault libraries assume that you have a service manual or at least a schematic for the set concerned, making extensive reference to the maker's component ID reference labels. They also tend to use a lot of service tech shorthand terms, such as 'LOP' for line output transformer, 'D/J' (or 'D.J.') for dry joint, and 'NSNP' for no-sound-and-no-picture. Although this would probably make them rather too cryptic for anyone other than service tech's, these are after all the people they're intended for, anyway.

I did note quite a bit of inconsistency, though — like H/OPT, LOP, L/OP, LOPTXER and FLYBACK TRANSF (all referring to the line or horizontal output transformer), and a few spelling errors. I gather that these reflect the differing origins of some of the fault/cure items, many of which come from clients in the form of update contributions. (Technical Applications provides updates twice a year, for $30, but gives discounts for contributions.)

The computer program version of the libraries is integrated, with both main databases and the additional 'appliance' database accessed via a single main menu. They come in compressed form on a high-density floppy disk, with a program to install them on your hard disk along with the viewing program.

The sample libraries installed very easily on a 286/12MHz machine, and using them in this form is certainly very fast and convenient. You need to print out the model cross-reference lists, though, to facilitate rapid access to the right chassis model.



All told, then, my impression of the Technical Applications fault libraries is that in either printed or program form they should be of value to any service technician involved in TV and video work.

The libraries are available direct from Technical Applications at PO Box 137, Kenmore 4069; phone (07) 878 1352, or fax (07) 378 1064.

Microprocessors

ADVANCED MICROPROCESSORS, by Daniel Tabak. Second edition 1995, published by McGraw-Hill. Hard cover, 155 x 235mm, 523 pages. ISBN 0-07-062843-2. RRP $160.

This book is not just a guide to today's microprocessors; it's about *all* types of microprocessors, including chips like the Intel Pentium, the PowerPC, the SuperSPARC and the 68060 from Motorola.

It starts with an overview of microprocessor (uP) development and goes on to describe the general structure of a uP. Memory hierarchy and pipelining are each given a separate chapter, which leads to a discussion of RISC uPs. Then follow chapters on the Pentium and earlier Intel 80xx chips; the Motorola 680x0 family, the 68060 and 68040 and the earlier 68000 uP's; Advanced RISC Microprocessors; the DEC Alpha AXP; the PowerPC family; the Sun SPARC; the MIPS Rx000; the Intel i860; the Motorola M88000 and the HP Precision Architecture families. The last section is about developing a microcomputer, where the author explains how to go about designing a system best suited to your needs.

The book contains listings of instruction sets, programming models and many block diagrams, and the writing style is concise and to the point. It's not a book for beginners, but anyone serious about microprocessors will find it informative, and (at the time of writing) about as up-to-date as you can get.

The review copy came from McGraw-Hill, PO Box 239, Roseville 2069. It should be available from technical and larger bookshops. (P.P.) ❖

SHORTWAVE LISTENING

with Arthur Cushen, MBE

BBC monitors the world for news

Shortwave listeners not only find enjoyment in the entertainment field, but their listening brings them news from all over the world. This type of information gathering has been long established by the BBC, which has operated in this field for some 55 years. Today transcripts of radio and television broadcasts from over 140 countries in 70 languages are combined with news agency reports, in a service which operates 24 hours a day every day of the year.

The BBC monitoring station at Caversham Park, located west of London, has just completed a £1.5 million investment in upgrading its equipment. The station has made increasing use of remote receivers located around the globe, to hear local AM or FM programmes which normally would not be heard thousands of kilometres away. Any one of the 100 receivers at Caversham Park, where the monitors listen to the broadcasts, can select one of 32 aerials located some 8kms away. The remote receiving sites include Helsinki, Stockholm, Warsaw, Prague, Vienna, Kiev, Kuwait, Teblise and Pershawa, as well as information gathered from BBC correspondents scattered throughout the world.

The comprehensive nature of the information coming into the monitoring service is reproduced in various publications, including the *World Broadcasting Information* publication which is issued each week, highlighting the changes which have been noted in frequencies, languages and transmission times from stations all over the world. The BBC would rank as the largest monitoring service in the world, closely allied to the Foreign Broadcasting Information Service of the United States.

The early days of the BBC Monitoring Service were devoted to enemy propaganda and broadcasts, and much of the world's news on allied stations was supplied from the BBC monitors.

The *1947 BBC Yearbook* indicated that there was a new role for the Monitoring Service, as the war years had shown clearly its value as a source of foreign news for the benefit of the Home, Overseas and European news bulletins of the Corporation — and also as a reservoir from which the editors of bulletins and compilers of programmes for listeners abroad could draw background material.

The first requirement of an efficient monitoring service is a good reception site, where the maximum number of radio signals can be intercepted. The monitoring receiving station at Crowsley Park in Oxfordshire has been found almost ideal for this purpose, since it provided adequate land over which the most efficient aerial systems could be erected. It was also well removed from any residential area and public roads, which provide a source of electrical interference.

Some 10 years later the *BBC Yearbook* reported that the experience gained during and after the war amply confirmed the value of monitoring as a rapid and often unique source of information. Most Governments and broadcasting organisations throughout the world have since found it essential to maintain some parallel form of service.

In this continuing and complex task, the BBC Monitoring Service works in close cooperation with its American counterpart, which under a reciprocal agreement provides monitored material from the Far East and other areas inaudible in Britain.

Today the Monitoring Service is a vital component in news gathering. Readers of this feature will be aware of the informative nature of shortwave listening, when they can access news and information from foreign broadcasting stations much quicker than by any other source. ❖

AROUND THE WORLD

BELGIUM: Brussels Calling, in English is now broadcast from 0630 - 0700UTC on 6015 and 9925kHz to Europe, and on 9925kHz to Australia; 0900 - 0930 on 6035, 15,545 and 17,595kHz to Europe and Africa; 1800 - 1830 on 5910 and 13,685kHz; and 2100 - 2130 on 5910kHz; and 2230 - 2300 on 9925 and 13,800kHz.
This is only part of the schedule and the DX programme is heard on the Monday transmission.

ECUADOR: HCJB, Quito, has re-timed its DX Partyline to the South Pacific and it is now heard on Saturday at 0908UTC, after the news on 6135kHz.
The broadcast to Europe is from 0700 - 0830 with DX Partyline heard at 0738 on 6205. The SSB test continues on 21,455kHz and the power is now 1500W. The station is keen for reception reports, sent to: The Frequency Manager, HCJB, PO Box 17-17-691, Quito, Ecuador.

GUAM: KSDA is to use a 100kW transmitter beamed on a bearing of 345 degrees to test to Papua New Guinea and Northern Australia, getting the back beam, up to Saturday 24th June from 0900 - 1000UTC on 9530kHz. A new DX programme called Wave Scan is heard in the Sunday session. A new verification will be issued for reports.

HUNGARY: Radio Budapest has broadcasts in English to Europe 2000 - 2030UTC and 2200 - 2230 on 3975, 6110 and 7220kHz; to North America 0200 - 0230 on 6025, 9835 and 11,910kHz, and 0330 - 0400 on 5964, 9835 and 11,910kHz.

INDIA: All India Radio, Delhi has English to the Pacific, 1000 - 1100 on 15,050, 15,180 and 17,387kHz; and 2045 - 2230 on 9910, 11,715 and 15,225kHz.

INDONESIA: RRI, Banda Aceh has been heard at 0900 with Indian chanting on 3905kHz and covers the Papua New Guinea station, Radio New Ireland at this time. The RRI station is now 50kW.

NEW ZEALAND: RNZI has a new schedule effective up to the 30th of September: Monday - Friday at 1650 - 1849 on 6145kHz; 1850 - 2050 on 11,910kHz; 2051 - 0458 on 15,115kHz; 0459 - 0716 on 9570kHz; and 0717 - 1206 on 6100kHz. At the weekends opening and closing times vary.

TAIWAN: Taipeh's Voice of Asia has been heard on 9280kHz at 1000UTC with multi-language announcements including English. The programme is in Chinese and is of a Gospel nature. At 1100UTC WYFR's interval signal is heard and carried on the frequency, still in Chinese.

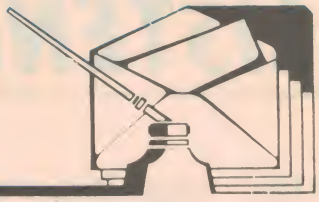
UNITED KINGDOM: The latest schedule for the BBC World Service to the Pacific, effective up to September 24th, is:
0500 - 0800 on 15,360kHz; 0900 - 1030 on 15,280kHz; 0500 - 0900 and 1800 - 2400 on 11,955kHz; 2200 - 2300 on 11,695kHz; 1130 - 1615 on 9740kHz; 1830 - 2200 on 9740kHz; and 1100 - 1130 on 6100kHz.
Radio Australia on 11,695kHz and RNZI on 6100kHz are the relays in this area. Early predictions indicated Russian interference may be noted on 9740kHz during the first period of transmission.

VATICAN: Vatican Radio has been heard now using 4010kHz in English at 1615 and Italian at 1630. The interval signal is heard at 1700UTC.

ZIMBABWE: Christian Voice has been heard with test broadcast at 0450UTC in English using 4965, 6065 and 7250kHz. The station is also testing at 1830 on 4965kHz. ❖

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind NZ Standard Time.

Information centre



Conducted by Peter Phillips

Party pieces, magnetics and high voltage caps

There's quite a range of information this month, including details of how to modify K3A and K9A Philips TV receivers to work with a VCR. A reader makes a few comments about the March What?? question, there's discussion on capturing lightning, and we give details of an ELF/VLF electric field meter.

This is the part of the magazine where we include anything we think useful, interesting or even entertaining. For this reason, you never quite know what the column will contain. In line with this philosophy, this month I'm including a number of letters that are not strictly about electronics, but nonetheless interesting. Of course, there's also letters about electronics. A reason for doing this is that I was reminded recently at a gathering that while electronics is a fascinating and engrossing subject, it doesn't give much food for social intercourse. Start talking about the latest microprocessor at a 21st birthday party, and watch people's eyes glaze over!

Over the years this column has covered some pretty wide-ranging topics, including a few that even the technically illiterate would find interesting. It's some of these that I'm drawing on to give you some party pieces, like this one...

Which side?

I've just been reading your Information Centre pages in the March edition of EA. As usual some entertaining and informative reading, for which I thank you. Under the heading of Blue Lights, you make mention of Henry Ford and the American left-hand drive. In a recent book called Made in America, by Bill Bryson, another reason is given why American drivers sit on the left.

The author writes about a form of horse-drawn transport known as Conestoga wagons. He says: "An unusual feature of Conestoga wagons was that they were built with their brakes and 'lazy boards' (a kind of extendable running board) on the left hand side. If there is a particular reason for putting them there, it has long since been forgotten. With drivers compelled to sit on the left, they tended to drive on the right so that they were positioned near the centre of the road, which is why it appears Americans abandoned the British custom of driving on the left. (Barry Freeman, Morphett Vale, SA.)

Thanks for this bit of trivia Barry, and thank you for your kind comments. It seems reasonable that the decision to drive on the right was the result of popular practice. However I'm sure I'm not alone in wishing the Conestoga wagon (if it's the reason) had been popular in other parts of the world. I have no preference for what side we drive on, but it would be nice if every country did the same.

Gross or Grob?

If you were studying electronics in the 1970's, it's likely you used a text book written by US electronics instructor Bernard Grob. Two books that come to mind are *Basic Electronics* and *Basic Television*. I mentioned the latter recently as a reference when discussing baluns, which has drawn this letter from a reader...

Having undertaken my TV Servicing course before it even came to us in black and white, I didn't use the book by Bernard Grob, as mentioned in your column. However, I think this author might have been wrongly named by a cruel quirk of fate. I suggest the author's name is Gross, not Grob, because of the German use of β (beta) as a replacement for 'SS'. If so, we perhaps owe the author an apology. (Sydney Clark, Alexandria Hills, Qld.)

You could well be right Sydney, although there's no reference to Gross in either of the Grob books I have. Still, quite a lot of Germans living in the US found it socially prudent to anglicise their name, particularly during both world wars. For instance, 1920s pianist Milton Suskind became Edgar Fairchild.

Lateral thinking

When I used this subheading before, it was in reference to a question (March '95) which asked for the next number in the sequence 1, 4, 7, 11. The answer was 14, and the lateral bit was because the number series was based on the use of characters made from straight lines. But there's another lateral way to view the question, as sent in by a reader. I'm sure you'll find it interesting and perhaps grist for another party piece.

When I was first presented with the puzzle 1, 4, 7, 11..., I prided myself in coming up with the answer of 15 in under 10 minutes. However, as we all know the answer is 14. My lateral thinking solution to this question goes like this:

The numeral 1 is written as 'one', having three letters. The next number is 4 (four), which has four letters. Then comes 7, with five letters and 11, which has six letters. So the next number must have seven letters, and the lowest number that fits this is 15. Oh well! (John Lew, Hurstville NSW.)

There's no right and wrong here. My solution is one way to view the question and to derive an answer. John's is another that is equally valid. In fact, I suppose there are hundreds of possible solutions. It's just unfortunate that the question and the answer have no use other than to demonstrate lateral thinking! But, as any serviceman knows, lateral thinking is often a useful fault-

finding technique, particularly when you've exhausted all other avenues. The lady who once insisted the cause for no sound was the picture tube might just be right. She could *see* the mouths move!

John has more to say on technical subjects later in this column, but for now we delve into a matter that although not really electronic, is certainly about electricity.

Capturing lightning

You might recall a letter from a reader (Patrick Mccool) seeking information about a suitable capacitor for storing lightning. I threw the question open to readers, and in March '95 I included a letter from Malcolm Watts (NZ) who had quite a bit to say on the dangers of lightning. But since then, despite Malcolm's and my warnings, Patrick has carried out some experiments, as explained in this letter...

First, thanks to Malcolm Watts for his concern and advice to readers telling them DON'T DO IT! However, we have now successfully captured a fraction of a lightning strike several times and are still doing it from time to time. We have readings of current and voltage as measured by a Fluke multimeter.

We understand Mr Watts' point of view about high voltage from lightning, and we are well aware that we are dealing with a very dangerous activity. We apply good and accurate planning, lots of care and of course use correct wiring and rewiring, based on lots of tests. If you want to do something, you have to be practical and cunning at all times, especially if you are dealing with a high and wild DC power source. So far the family, pets and all are still alive and kicking!

Getting back to the main purpose of this letter, we repeat that we are after up-to-date information on where to buy or get advice on how to assemble a suitable storage capacitor. Our aim is to only capture a small fraction of the power from a lightning strike, storing it in a small capacitor. Later we could increase the size of the capacitor and perhaps store more lightning. (Patrick and Julie Mccool, Sanderson, NT.)

Unfortunately you haven't given us any details of how you went about this, but full marks for, it seems, achieving something very few readers would be game to try — let alone succeed with. I've included this letter, first as I'm sure readers will be interested, and also to ask readers for any information that might help the Mccools in their experiments.

I wonder if a power factor capacitor as used in electrical substations might suit. These capacitors are physically large, have a very high voltage rating, although a relatively small capacitance, and can be disassembled for repair. However, I'm sure they are not readily available to the public.

But Patrick, perhaps you could ask your local electricity supply authority. Even if they can't directly help, perhaps they might be able to refer you to a supplier. Another source might be a radio station. High voltage capacitors are used in radio (or TV) transmitters, although again I suspect the capacitance will be too small. Still, you might be able to get a number of them and connect them in parallel.

The next letter is also from a Northern Territory reader, who seeks information about attracting lightning — not for storage, but for other purposes.

I was interested in your letter regarding lightning experiments from your Darwin correspondent in December. I live in Alice Springs and we also get spectacular lightning displays from dry storms during summer. One of my main interests is photography, and I usually set up my cameras on a suitable hill to capture lightning on film. I have some quite remarkable photos as a result.

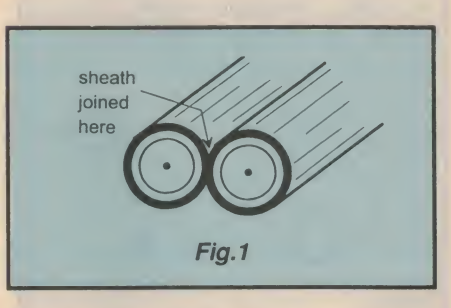


Fig.1

I am interested in building a system to attract lightning. This idea comes from the US, where scientists launch a small rocket trailing a fine wire aloft until it induces a lightning strike. This principle would be handy to set up a lightning strike in the subject area of a photo, and possibly it could also be used to take a measure of the lightning by attaching the end of the wire to a suitable capacitor and measuring apparatus.

The main problems would be a remote control for rocket ignition, a suitable rocket (possibly a model from a hobby shop), determining the best time to launch the rocket to achieve lightning ignition, and the distinct possibility that repeated lightning strikes in my backyard would disturb the neighbours! (Ian Ross, Alice Springs, NT.)

The remote control system could be a single-channel UHF unit, but I'm not sure about the availability of a suitable rocket. I seem to recall there are overseas magazines devoted to the hobby of rockets, so it shouldn't be too difficult to get something. However, if I was your neighbour, I'd be rather alarmed at this activity, so perhaps you might need to fire the rocket over an uninhabited area. You'll get better scenery, anyway.

Magnetics

In case you're starting to wonder when the subject matter will become technical, try this letter. It comes from a regular correspondent to this column who often takes me to task.

I see you are being provocative again, in asking for a single answer for a What?? question that is incompletely specified. The March question about the transformer with two resistors in circuit is the case in point. The electrical part is adequate, but the magnetic conditions are not.

For a correct answer it is vital to know how much of any increase or decrease of flux in the core cuts the various parts of the secondary winding. Neither the question nor its explanatory diagram (Fig.3) gives any clue about this. Consider three (of a wide number) of possible cases:

1. A pot core where flux changes are evenly received by each element of length of the winding.

2. A toroidal core (or its 'square' equivalent with at least one cylindrical leg to conform with Fig.3), and with the 1 ohm resistor and/or its half-winding in the window.

3. As for 2 but with the resistors interchanged.

My analysis of each is:

For case 1, each half of the winding obtains equal exposure to changing flux and there is a voltage of 3/2 = 1.5V induced in each of the half turns A-B and B-A. In the one ohm half, this is reduced by the 1V drop caused by the current of 1A, so the A-B voltage is 0.5. For the other half, the 1.5V is reduced by the current in the two ohm resistor to 2V. This voltage leads the B-A voltage, so the A-B voltage is 0.5V.

For case 2 all flux changes cut the half-turn 'inside' the window, inducing 3V in it. The outside half sees no flux and no induced voltage. In effect the inner half has an internal impedance of one ohm, decreasing its effect at the terminals by 1V. That is, 2V is seen between the terminals, exactly what is needed to drive the 1A through the two ohm resistor in the outer half.

For case 3, the same treatment as 2, but with the two ohm resistor inside, leading to 1V between the terminals. By the way, re the definition of 'inside' the

core-space: anywhere in the winding space that a wire can be cut by a line of force as it collapses to zero diameter when flux is reduced. (I mention this because some people have problems handling this concept). There are other treatments of magnetics, but this works for me. (E. Gordon Wormald, Florey, ACT.)

Thanks for this, Gordon. Obviously the question needed more detail, perhaps to define the exact type of transformer. Still, yours is the only letter I've received, so possibly other readers didn't get so involved and saw the transformer as a conventional device, not a pot core type. I'll try and be more careful next time; at least that's my story.

VCR mods for Philips TVs

In March a reader (B.F. Cooper, Turramurra) wrote asking if anyone could supply the modifications so his TV set could work properly with a VCR. The receivers in question are Philips KD655 and Philips KJ239. Several readers have sent me the necessary information, starting with the following:

After reading your March issue, I noted you needed some VCR modification information. After digging around, I located all the mods I have on Philips TV sets. My information is based on chassis numbers only, so I have matched these models to a chassis. For the KD655 (K9A-2 chassis), use the K9A modification. For the KJ239 set, which has a KT3A-1 chassis, use the KT3A modifications. (Brad Hawkins, Taree, NSW.)

Here's the information sent to me by Brad, who from his letterhead, runs a TV servicing business.

For Philips KT3A, KL9A, this alteration is used to improve frame synchronisation when the set is used with a National NV7000A VCR.

Step 1. Ensure the sync module (U475) has a TDA2571AQ IC (this applies for all types of VCRs).

Step 2. Copper side: (a) increase the value of C522 to 690uF by adding a 470uf 16V electrolytic capacitor in parallel. (Later models have a 1000uF capacitor); (b) cut the PCB track at pin 3 of U475; (c) connect a 220k resistor between C541 and the base of Q514 (ie, pin 3 of U475 is now no longer connected.)

Step 3. U475 sync module: (a) ensure R375 is fitted. If not, fit a 470 ohm resistor in series with C374 (to pin 15 of IC367); (b) reset the frame free running frequency; (c) check the frame linearity, and adjust if necessary; (d) remove R399 (180 ohm).

Philips KT3A chassis, line control module U475 switch to VCR, final channel position or line control module U475. Connect pin 19 to junction of R381 (27 ohm) and C386 (47uF) and R393 (3.3k) (12V DC). For Philips K9A, K11A chassis, models using line control module U330, join pins 11 and 8, and join pins 10 and 3.

Next is more information from R. Percy, (Pambula Beach, NSW) who is also a serviceman:

For the KD655 (which is a K9A-2 chassis), join pins 11 and 8 and join pins 10 and 3 (as already described). For the KJ239 (KT3A-1 chassis), this chassis does not normally require modification to work with a VCR if you tune the VCR to the last tuning position (normally 0 or U).

However if you want to use another tuning position, do the modifications already described for this chassis.

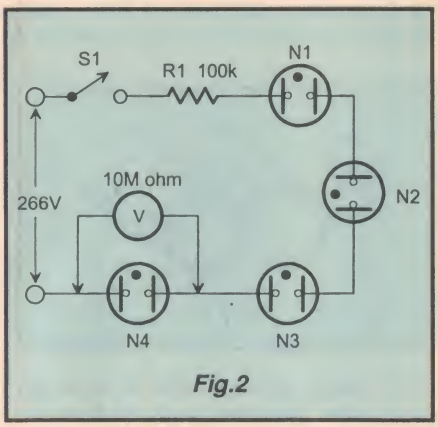


Fig.2

And finally, a reader (who I assume is not a serviceman) has supplied this information about the Philips K9.

I have a Philips K9 TV receiver, 1975 model and modification instructions from Philips. The modification is to the small signal panel. R4 is a four-pin socket and you need to connect pin 1 to pin 3, and pin 2 to pin 4. (Len Rozife, Hastings, Vic.)

Thank you for this information, Len. Yes, the last modifications seem to be different to the first two, but I can only present the information in the hope that those stuck with trying to do it can work out which set of instructions applies. I assume there's a difference between a K9 chassis and a K9A chassis. Good luck!

Electric field meter

In March I included information on where to get a milligauss meter, to measure the electromagnetic field produced by a power line. At the time, I did not know where to get an instrument capable of measuring the electric field as well.

A supplier of these meters has since contacted me: RFI Industries, of 54 Holloway Drive, Bayswater, 3153; phone (03) 762 6733, fax (03) 762 8501. This company also sells milligauss meters.

To give you an idea of what an ELF/VLF electric field meter is, here's an extract from a promotional brochure describing the Holoday HI-3638:

ELF range, 2Hz to 2kHz; VLF range, 2kHz to 400kHz. Dynamic range 0.4V/m to 40kV/m. The digital remote readout included with the meter is isolated from the sensor with a two metre fibre- optic cable. Using optional extended cable lengths, the meter can be separated from the readout by up to 300 metres. The instrument is battery powered (NiCad) and can operate for 40 hours. The sensor has a diameter of 305mm and weighs 1kg. The sensor (looks like a satellite dish) fits on a tripod and connects via the fibre-optic link to the meter. The sensor can also be connected directly to a computer.

The instrument is used in low field measurements (eg, from a computer monitor) to higher field environments like those near power transmission lines. I have no details on price.

Saba TV remote

Remember Saba TV sets? The following is from a reader seeking information about the remote control system used by these receivers.

I am a hobbyist, and have been given three small, reversible 25V AC electric motors. They feature built-in gearing and a clutch and were part of the remote control system of an old Saba TV set. Apparently the remote control system works at a certain frequency. I am after information about the system and in particular the power supply circuit. If anyone can help, I'll be glad to reimburse any costs. (M. Wolff, PO Box 116, Surfers Paradise 4217.)

As far as I remember, the Saba system, like others at the time, used an ultrasonic remote control system, but with different frequencies for each function. The motors are used to drive the channel changer, volume control and probably the brightness control. If anyone can help, perhaps you could contact Mr Wolff at the address given.

Twin coax impedance

Here's a question for all you transmission line buffs:

At my last place of employment, a computer system costing around $600,000 was installed. The data in the

system is transmitted to and from the various terminals using two runs of 75 ohm coax.

Apparently to make installation easier, the cables were joined together by their sheaths as shown (see Fig.1). My question is, if the cable was used as a balanced transmission line, what is its characteristic impedance? (David Allen, Findon, SA.)

When we discussed this in the office, we decided that it was almost impossible to say, as the coupling between the lines caused by the shield would create so many unknowns. But transmission lines, like antennas (and baluns!) follow a different set of rules to most branches of electronics, and often defy rational analysis. It would be interesting to measure it.

Kits and projects

We pick up here the rest of John Lew's letter, which has a few comments about tuner kits and an idea for a project:

Whatever happened to tuner kits? I for one would love to construct one for my hifi. Amplifier and speaker kits are constantly described and sold, but no tuner kits. Are those who want to build as much of their hifi system as possible a dying breed? Or has the cost of commercial items made you conclude that a tuner kit wouldn't sell?

I would also like to offer a project idea. I want to build or modify a clock radio so it only goes off on certain days of the week (like Monday to Friday), according to the settings of switches. I appreciate my weekend sleep-in. (John Lew, Hurstville NSW.)

The most recent tuner we have described is the Playmaster AM/FM Tuner, presented over a number of issues in 1986. Others include the Playmaster Stereo AM/FM Tuner (December 1985) and the Playmaster HiFi AM Tuner over various issues on 1983. Since then, I must agree, we have not presented any further tuner projects.

Our reasoning for not presenting more tuner type projects is along the lines you suggest, John, as commercial tuners are now very refined, yet cheap. However, the performance of the Playmaster AM/FM Tuner is quite respectable, and it might still be available as a kit.

As for the clock radio project, this seems an excellent idea and one we might look into. Again cost could be a limiting factor, but the novel feature you suggest could make it worthwhile.Thanks for the suggestion.

What??

This question comes from Jim Lowe, who originally presented it as a question for TAFE NSW electrical teachers and students.

In the circuit of Fig.2, each neon lamp needs a minimum of 74V to ionise, so four in series require 296V. After firing, the voltage drop across each lamp is 59V. Because the supply voltage to the circuit is 266V, the lamps don't light when the switch is closed.

However, what happens if a DVM (with a resistance of 10M ohms) is connected as shown, and the switch is closed? What will the meter read, and what will happen when the meter is taken out of the circuit?

Answer to May's What??

The average speed is 30kph. Let's assume each hill is 20km high. At 20kph, it takes the car one hour to reach the top, and at 60kph it takes 20 minutes to descend.

The total time to travel 40km is therefore 80 minutes, giving an average speed of 40/1.3333 = 30kph. Averaging the two speeds doesn't give the right answer! ❖

LAMP INVERTER

Continued from page 63

tion on CFLs for details of the different types of CFLs.)

Otherwise, carefully check your construction. If all is well, it's now a matter of deciding what to do with the inverter. There are plenty of options, as we'll now describe.

Applications

As we've already explained, there are three main options: using the inverter with one or more CFLs, with a 20W electronic ballast and fluorescent tube, or with a 36W dimmable electronic ballast and tube. The DC supply to the inverter can range from 10V to 15V.

The obvious application is internal lighting from a solar-powered 12V battery charging system. This could include boats, caravans, camp sites and of course, a residence. Because the one inverter can drive several lamps, you could even use conventional house wiring to connect the lamps.

This way, a conventional light switch can be used to operate a light driven from the inverter. While a typical light switch is only rated for AC, the current taken by a 20W lamp at 350V DC is less than 60mA, which should be well within the rating of a 10A AC rated switch. Because the inverter draws a no-load current, some arrangement is needed with a multi-lamp system to isolate the inverter from the 12V supply when all lamps are off.

Another application is a low voltage garden lighting system. With this arrangement, run a 12V supply to each lamp fitting, and install an inverter in each one. A low cost fitting made from a large Nescafe coffee jar and PVC plumbing is shown in Fig.7. This fitting was made with 90mm SWV pipe, which is readily available from most hardware shops. The jar was joined to the pipe with a 90mm joiner, and the total material cost was around $4.

The wiring to the fittings has to have a low resistance, to keep the voltage drop as low as possible. However, the light output of a CFL is virtually constant for an input voltage to the inverter down to about 10V. Remember too that the electronic ballasts referred to in this article can also be powered directly from 240V AC. So there's really quite a few options available. ❖

PARTS LIST

Resistors

All 1/4W, 5% unless otherwise stated:

R1	3.3k
R2,3	22 ohm
R4	100 ohm, 5W
R5	220k
R6	270k
R7	6.8k

Capacitors

C1,4	0.47uF monolithic
C2	4.7nF polyester
C3	68nF ceramic
C5	220 to 1000uF electrolytic
C6	22nF to 470nF 250V AC rated

Semiconductors

D1,2	BA159 or PLQ1 power switching diodes
D3-6	BA159 or MR856 power switching diodes
IC1	SG3525 switching IC
Q1,2	P222 or MPT50N05E MOSFETs

Miscellaneous

PCB 125mm x 40mm; transformer to suit; optional heatsinks; optional 16-pin IC socket; hook up wire.

A kit of parts for this project is available from:

Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.

Inverter kit, PCB and all on-board components including transformer and P222 MOSFETs	$24.00
Inverter kit and 7, 11 or 15W CFL to suit	$36.00
Inverter kit and 20W electronic ballast	$36.00
Inverter kit & 36W dimmable electronic ballast	$40.00
Post and pack charges	$5.00

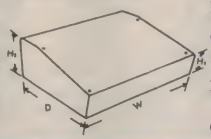
AUSTRALIA WIDE • Overnight Delivery • ALTRONIC COMPONENTS

Sloping Front Console Cabinets

Molded from high impact ABS plastic, this range of boxes have a sloping 1mm aluminium face plate to give your project that real professional look.

Features:
• Generous ventilation slots, to allow for adequate air flow • Molded bosses, or stand-offs to accommodate PCB's direct onto the base of the box • Integral brass inserts to accept the front panel holding screws • Stylish brushed natural aluminium face plate • Supplied with stick on rubber feet and self tapping screws for securing PCB's

	W	D	H1	H2	
H 0434	105	143	31	55	$12.95
H 0436	170	143	31	55	$15.95
H 0438	170	213	31	82	$22.95



At Last - An Accurate

Digital LCR Meter

In the past multimeters including inductance and capacitance ranges have been relatively mediocre in their performance. This new model will measure inductance, capacitance and AC resistance with great accuracy! Ideally suited for speaker crossover design and transformer/coil manufacture. Supplied complete with two sets of leads and inbuilt sockets for direct measurement of inductors, capacitors or resistors. Includes integral bench stand.

Ideal for Designing Speaker Crossovers Etc

Specifications:
Resistance Ranges:....20Ω, 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
Capacitance Ranges: .200pF, 2nF, 20nF, 200nF, 2µF, 20µF, 200µF
Inductance Ranges:...2mH, 20mH, 200mH, 2H, 20H, 200H
Accuracy:.....better than ±5%
Display:.....3.5 digit LCD

Easily the Best LCR Meter We Have Ever Evaluated!

Q 1010 $199.00

Extra Large 22mm Digit DMM

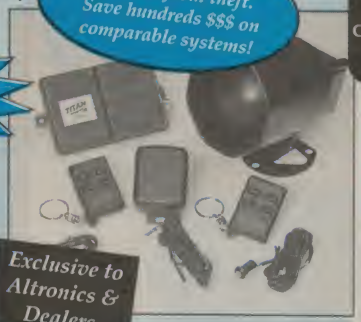
Includes Capacitance Ranges and Temperature Meter.
Features:
• Capacitance measurement • Temperature measurement (includes thermocouple) • Resistance to 200M ohm • Diode check and continuity buzzer • Transistor checker • Auto power off after 15 minutes • Massive 20A DC range

Supplied Complete with 'K' Type Thermocouple for Temperature Measurement

Specifications:
DC Voltage Ranges: 200mV, 2V, 20V, 200V, 1000V
Input Impedance:.....10MΩ
AC Voltage Range:.....2V, 20V, 200V, 700V
Input Impedance:.....10MΩ
DC Current Ranges:...2mA, 20mA, 200mA, 20A
AC Current Ranges:.....200mA, 20A
Resistance Ranges:.....200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ, 200MΩ
Capacitance Ranges:2nF, 20nF, 200nF, 2µF, 20µF

Q 1060 $89.95

Multi-Function Remote Car Alarm



Protect your car from theft. Save hundreds $$$ on comparable systems!

Easily the Best Car Alarm We Have Ever Evaluated!

Exclusive to Altronics & Dealers

This amazing model features just about everything you could imagine. Multi-function key ring remote control will arm and disarm alarm (and activate central locking if fitted), panic and even open the boot (if actuator fitted). Other features include starter inhibitor, valet mode, central locking interface, flashes car indicators when tripped, auto reset, user programmable options plus much more. Also includes two spare electric outputs which are operated by the key ring remote control, these can be used to chirp the horn, turn on the car headlights or a myriad of other functions! Can be configured to automatically re-arm if a door is not opened within 22 seconds after disarming (avoids accidental disarming). Full battery backup siren includes built-in batteries, charging circuit, siren and key on/off switch.

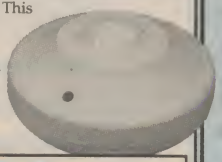
Features: • Supplied complete with two miniature remote controls • Remote arming and disarming • Super Loud 127dB siren • Remote panic function • Full battery backup and tamper proof siren • Child proofing and anti intrusion alert while driving • User selectable exit delay and automatic re-arming • User selectable arming/disarming chirp • User selectable auto arming • Starter disable • Valet mode can be activated by remote or glove box switch • Automatic shunt of any defective entry zone • Turns on interior lights for 20 seconds when alarm is disarmed • Alarm memory indicates which zone (1-3) triggered • 60 second siren with auto reset • Two colour LED status indicator • Can be interfaced with central locking (where fitted) • 3 extra channels on remote to control other vehicle features such as boot release, etc

S 5205 ONLY $199.00

360° Ceiling Mount Passive Infra-Red Movement Detector

Incorporates Pulse Count Triggering

With an attractive slimline design, this ceiling mounted detector offers a great degree of protection. Ideal for offices, factories, shopping centres etc with wide expanses, where the walls are too far apart for conventional wall mounted movement detectors. This unit is also ideal for home systems to protect individual rooms. Covers area approx 4 x 11m at 110°.



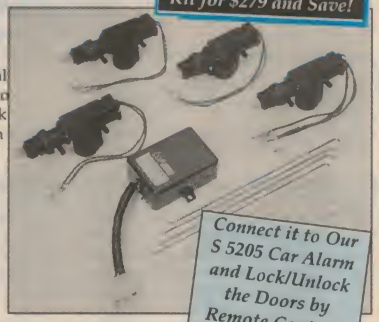
S 5310 $69.95

Buy Both the S 5205 Car Alarm and the S 5237 Central Locking Kit for $279 and Save!

Central Door Locking Kit

All four doors will automatically lock or unlock with the operation of either of the front doors.

Add the ease and convenience of central locking to your car. Can be interfaced to our S 5205 car alarm (and others) to lock or unlock all four doors when the alarm is remotely armed or disarmed. Includes all the mounting hardware to fit to most cars. The actuators are motorised with an inbuilt gearbox to ensure reliable and positive operation. One actuator is mounted inside each door. Includes central control unit which mounts under the car dash. For use with 12V negative earth systems.



Connect it to Our S 5205 Car Alarm and Lock/Unlock the Doors by Remote Control!

S 5237 $119.00

Famous Maestro Internal Fax/Modems

Fantastic Offer at Never to be Repeated Prices!!

Using the latest in digital signal processing these modems will give you years of service. All models are supplied with Quicklink II Fax software and are backed with full support by Maestro. Quicklink II offers some great features like sending faxes to several numbers simultaneously, viewing incoming and outgoing faxes on-screen, receiving faxes in the background while using other programs, scheduling faxes, and much more!

Only 3 Left!

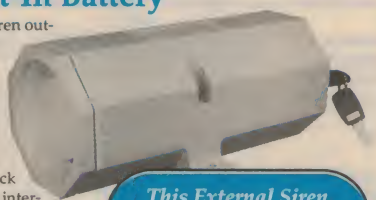
Only While Stocks Last! Sorry - Not Available from Altronic Resellers

Only 5 Left!

D 1610 Economy Internal Fax 9600/Data 2.4.kbps
Normally $249.00
This Month Only $159

D 1620 Exec Internal up to Fax/Data14.4kbps Normally $549.00
This Month Only $299

Self Powered Electronic Piezo Siren with Rechargeable Built-In Battery



Self contained unit. Incredibly loud siren output of 120dB. Connects to 12V DC. If either the trigger or power wires are cut, the siren will sound. Will also sound if the car's battery is dis-connected. Simply armed and disarmed via inbuilt key switch (2 keys supplied).

Features: • 120dB output • Built in back up battery • Compact design • Easily interfaces with house or car alarm • Easy key switch operation

S 5235 Normally $69.95
This Month Only $39

This External Siren will Immediately Sound if it's Wires are Cut. Includes Internal Rechargeable Batteries!

Speaker Protect Grills for Your Mobile Disco or Stage Sound Gear

Add some class to your speaker cabinets with this professional series of wire grills. Sturdy steel construction features plastic surround and open grid appearance. Each includes 4 fixing clamps. Black only.

To Suit Speaker Size	
C 3706	6.5" (165mm) $8.95
C 3708	8" (200mm) $10.95
C 3710	10" (250mm) $13.95
C 3712	12" (300mm) $16.95
C 3715	15" (380mm) $19.95

Each includes 4 fixing clamps

Strong Sturdy Steel Construction!

ALTRONICS - FAX (09) 328 3487

FREECALL 1-800 999 007 PERTH (09) 328 1599

ALTRONIC COMPONENTS • Overnight Delivery • AUSTRALIA WIDE

ALTRONICS - FAX (09) 328 3487

Wireless Diversity Microphone Systems

These professional wireless microphone systems are as used by the industry for stage and studio productions. Featuring stylish good looks and the latest microchip technology they offer outstanding performance and sound reproduction both for voice and instrumental applications. True Diversity Reception means two receivers with separate antennae are employed. An on-board microchip monitors the signal strength and reception fidelity of either A or B receiver and automatically outputs the highest quality signal. Each system includes a receiver unit and a hand held microphone. The receiver operates from 240V AC and simply connects to an amplifier with a line level input. The microphone requires a 9V battery (not supplied).

Two Frequencies Available:
System 1 - 202.5MHz
System 2 - 202.9MHz

As Used by Professionals for Stage and Studio Productions

Made by NADY SYSTEMS USA.

Each System
Normally $744.00,
This Month Only **$544** Complete System

1GHz Frequency Counter

This multiple-function counter covers a range of 10Hz to 1GHz. It includes an eight digit, seven segment, LED display, low power consumption circuit design, small size, light weight, highly stabilised crystal oscillator for accurate measurement and full input signal conditioning.
Q 1535
Normally $399.00
This Month Only **$299**

A Must for Servicing and Aligning VHF Radios, Radio Mics, Signal Generators etc.

Famous Labtech 20MHz Dual Trace Oscilloscope

Now With Component Test Function!

This model is a dual trace, 20MHz oscilloscope with a high brightness CRT. The vertical amplifiers have high sensitivity of 5mV/div and a frequency characteristic response with a smooth roll off exceeding 20MHz. The TV sync. signal operator circuit is provided to ensure stable observation of video signals. Triggering is obtained by sampling the AC power waveform, external waveform or internally generated trigger.

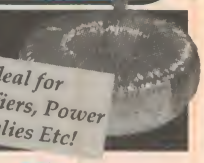
Now Over 2000 in service throughout Australia including many 100's in Universities, Research Establishments and Industry

Q 0156 Normally $729.00
This Month Only **$649**
Q 0175 Cro Probes to Suit $49.95 Each

Q 0175 Cro Probe

35 Volt Toroidal Transformer Sellout Bargain - Save 50%

160 watt rating. 35V - 0 - 35V output. 240V input.
M 3070 Normally $79.95, This Month Only **$35**



Ideal for Amplifiers, Power Supplies Etc!

The Powerhouse 1200W Inverter Kits

Connects Direct to Your Vehicle Battery to Produce 240V AC!

(See EA Feb '92) This Power Inverter will provide all your power requirements from a heavy duty 12 or 24V battery. Using the latest Mosfet output stage and toroidal transformer this inverter is both efficient and will deliver high surge currents. The Powerhouse has been designed not only for rugged bullet proof operation but for ease of construction, two PCB's hold all circuitry with one inter-connecting cable. This kit comes to you in a fully drilled, pre punched chassis complete with silk screened front panel. Suitable for use in camping, boating, fishing, mining, farming, remote settlements etc.

K 6796 Kit Version 12V Input
K 6798 Kit Version 24V Input **$799.00**
K 6797 Fully Built & Tested 12V Input
K 6799 Fully Built & Tested 24V Input **$999.00**

Incorporates New Micro-Processor Controlled Circuitry for Improved Performance!

Genuine Austel Approved Telephone Line Isolation Transformers

These PCB mounted transformers are used by manufacturers throughout Australia. They feature an impedance of 600Ω for the input and output windings. Full specifications are available upon request.
M 1000 Normally $13.95
This Month Only **$6** ea
Or Buy 10 and up **$5** ea

A Must for any Equipment Which is to be Connected to the Phone Line. Ideal for Security Diallers, Modems, Diverters etc!

Save An Incredible 60%

ALTRONICS

174 Roe St. Perth W.A. 6000
Phone (09) 328 1599, Fax (09) 328 3487
MAIL ORDERS C/- P.O. Box 8350
Perth Business Centre, W.A. 6849

Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $10.00, 3kg to 5kg is $18.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs.

Insurance: As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance".

Altronics Resellers: Chances are there is an Altronics Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

WA - COUNTRY

ALBANY	BP Electronics ●	(098) 412681
	Micro Electronics	(098) 412077
BUNBURY	Micro Electronics	(097) 216222
ESPERANCE	Esperance Comm.	(090) 713344
MANDURAH	Forum Electronics	(09) 5813466
PORT HEDLAND	Ivan Tomek Electronics	(091) 732531
ROCKINGHAM	TV Joe's	(09) 5271806

VIC - CITY

	All Electronic Comp.	(03) 6623506
	TECS ●	(03) 6706474
CHELTENHAM	Talking Electronics	(03) 5842386
CLAYTON	TECS ●	(03) 5629501
CROYDON	Truscott Electronics ●	(03) 7233860
FOOTSCRAY	G.B. Telespares	(03) 3266035
PRESTON	Preston Electronics ●	(03) 4840191

COUNTRY

BALLARAT	Ballarat Electronics	(053) 311947
BENDIGO	Sumner Electronics	(054) 431977
MILDURA	Truscott Electronics ●	(050) 238138
SHEPPARTON	Andrew Guyatt Elect.	(058) 219497

QLD - CITY

	Delsound PL●	(07) 8396155
NEWSTEAD	E.C.Q.	(07) 2541153
WEST END	B.A.S. Audiotronics	(07) 8447566
WOODRIDGE	David Hall Elect.●	(07) 8082777

COUNTRY

GLADSTONE	Gladstone Elect. Services	(079) 724459
MAROOCHYDORE	Mals Electronics ●	(074) 436119
TOWNSVILLE	Super Solex ●	(077) 724466

TAS

HOBART	G.H.E. Electronics ●	(002) 342233
LAUNCESTON	G.H.E. Electronics ●	(003) 316533

NT

ALICE SPRINGS	Farmer Electronics	(089) 522388
KATHERINE	Logicware	(089) 723030

SA - CITY

	Force Electronics ●	(08) 2125505
BRIGHTON	Force Electronics ●	(08) 3770512
ENFIELD	Aztronics ●	(08) 3496340
FINDON	Force Electronics ●	(08) 3471188
HOLDEN HILL	Force Electronics ●	(08) 2617088
LONSDALE	Force Electronics ●	(08) 3260901
SALISBURY	Force Electronics ●	(08) 2830755

NSW - CITY

	David Reid Elect. ●	(02) 2671385
SMITHFIELD	Chantronics	(02) 6097218
YAGOONA	Delta Components	(02) 7962888

COUNTRY

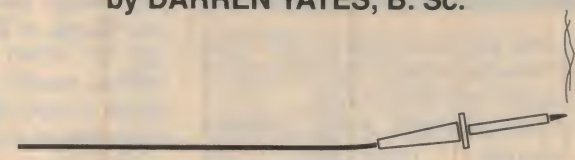
COFFS HARBOUR	Coffs Habour Elect.	(066) 525684
NEWCASTLE	Novocastrian Elect.Supplies	(049) 621358
WARNERS BAY	Vilec Distributors	(049) 566792
WOLLONGONG	Newtek Electronics ●	(042) 271620
	Vimcom Electronics	(042) 284400

FREECALL 1-800 999 007 PERTH (09) 328 1599

Doc.JH183

Experimenting with Electronics

by DARREN YATES, B. Sc.



Putting transistors to use

If you're looking to start designing your own circuits and building your own projects, then you won't come across a component more versatile than the transistor. Over the next couple of months, we'll look at some of the many ways you can use a transistor to great effect.

There is an attitude in society which seems to suggest that we make things simpler by making them more complicated. You only have to look at the number of microprocessor-controlled widgets and whizzbangs floating around — washing machines, videos — just about everything you can buy.

Now while they obviously allow more people to *use* the products, anyone who wants to service their own widget is in for one heck of a nightmare.

As far as active electronic components are concerned, the transistor would be the most useful and simplest to use. In essence, it's operation is fairly simple — a small current is applied to the base to control a much larger current flow between the emitter and collector. It's this *amplification* capability of the transistor that makes it so useful. However, there are many other things you can do with it besides making a simple amplifier, as we shall see over the next couple of months.

A simple amplifier

If you've never seen one before, then here it is in Fig.1 — the world's simplest audio amplifier. It's a 'common emitter' design, so called because the emitter is the common connection between the input and output signals. This circuit uses a current bias at its base, supplied by the 1MΩ resistor. It also provides the negative feedback for the circuit too. Let's see how this works.

When power is first applied, Q1 is suddenly turned on by the current flow through the 4.7kΩ collector resistor and the 1MΩ bias resistor. As the transistor turns on, the collector voltage decreases. This reduces the amount of bias current to the base, which forces the transistor to begin turning off. As it turns off, the collector voltage rises. More current flows to the base and Q1 turns on again.

This apparent swaying between one state and the other all happens quite rapidly and with the components and supply voltage specified, the collector voltage quickly reaches half the supply rail, the ideal spot for the output of an audio amplifier.

The two 0.1uF capacitors isolate the input and output from the DC voltages, to ensure that the DC bias points are not upset by outside loads.

The input impedance is only fairly low, due to the fact that there is no emitter resistor in this circuit. The AC input impedance of the circuit is roughly equal to the beta (current gain, or amplification factor) of the transistor, times the internal emitter resistance of the transistor.

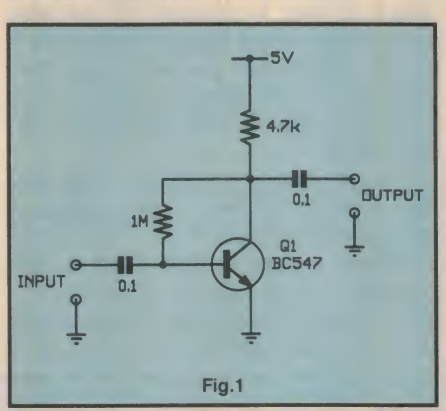


Fig.1

This last factor is often known as 'little r-e' and in our circuit, it is around 25 ohms. multiply that by 100 as a minimum figure for the gain of a BC547 transistor and you get an overall input impedance of around 2.5kΩ.

The output impedance is much easier to work out. As a rough guide, it is simply the value you have for the collector resistor — in this case, 4.7kΩ.

Now while you can't connect a loudspeaker to the output and expect to hear an awful lot, you can easily use it as a cheap microphone preamplifier. It will provide a gain of around 200, which is more than enough to drive your stereo system to a suitable level. Connect up a dynamic microphone to the input and the output to the line input of your stereo, and you've got a simple karaoke mic system.

Better control

The old saying is 'whatever can be done with one, can be often done better with two', and this is very true when it comes to transistor amplifiers. The circuit in Fig.2 is an equally common circuit and included for completeness; however it does have a number of advantages over the circuit in Fig.1.

Firstly, it has a much higher sound quality. In more technical terms, it has a lower amount of total harmonic distortion (THD). Simply, this is the amount of extra nasties the amplifier itself adds to the output signal. While you can't get rid of it completely, you can reduce it down to inaudible levels.

The new circuit has a much more stable method of applying negative feedback. In this case, the feedback is taken from the output (as before) via a 2.2kΩ resistor from the collector of transistor Q2, and fed to the emitter of Q1. Now while it may not be obvious, the emitter of Q1 is actually another input point. A signal applied to the emitter of a transistor will appear in the same phase at the collector.

The 100Ω resistor R1 and the 10uF capacitor, along with the 2.2kΩ feedback resistor R2 form a voltage divider for the feedback, which is extremely stable. By stable, I mean that it is not varied by the characteristics of the transistors used.

In Fig.1, the feedback, and hence the overall gain which we'll get to shortly, is controlled by the beta of the transistor. The problem here is that transistor betas can vary over a range of 4 to 1 and more. Some types of BC547's will have a beta

of 100 and others as high as 400. This type of variation ensures that the gain of Fig.1's circuit will always vary.

By contrast, the gain of Fig.2's circuit is simply 1+(R2/R1), or 1+(2200/100)=23 as in the case of our circuit. To increase the gain, you reduce the negative feedback and vice versa. This is done by reducing or increasing, the 100Ω resistor. If you change the 2.2kΩ resistor, you will upset the DC bias points; so always stick with the same value of R2.

Strictly speaking the 33kΩ collector resistor on Q1 is not necessary, but it greatly reduces the amount of distortion — by a factor of five or more. It helps to linearise the current flow through the base of Q2.

The output voltage, at the collector of Q2, is set to 4.5V with a 9V supply rail and is set by the 100k and 150kΩ resistors biasing Q1. The base bias voltage of Q1 sits about 0.6V above half the supply rail, to allow for the 0.6V drop across the transistor's base-emitter junction. You can vary the supply voltage over a range of 6-18VDC and the output will be pretty close to half the supply rail. This ensures that the circuit can deliver the maximum voltage swing with little distortion.

Another factor which adds to THD is hum, or 50Hz leakage from your power supply into the audio path. If you're running from batteries, this is generally not a problem; but if you're running the circuit from a plug pack, you'll find quite a bit of hum getting through via the supply rails.

The 10kΩ resistor and 10uF capacitor on the left together act as a very low-pass filter, to remove the mains hum leakage and ensure that the input bias voltage for Q1 is as stable as possible.

The output impedance here is again determined largely by the collector resistor of Q2, and in this case, is approximately 1kΩ. The benefit of this circuit though is that the output impedance can be either reduced or increased without greatly affecting the overall gain of the circuit, since the collector resistor is not part of the feedback network.

This circuit has a distortion figure of around 0.1%, but with higher supply voltages (i.e., around 18V or so) the distortion can drop as low as 0.05%.

More noise

While transistors can be used to amplify other noises, they can also be used to generate their own. The simple circuit in Fig.3 is a square wave oscillator which starts as soon as you apply the supply voltage. It's official name is a 'cross-coupled astable multivibrator' — 'cross-coupled' because the RC components connect the output of each transistor to the input of the other, 'astable' because neither transistor has a stable operating state, and 'multivibrator' because it continues to oscillate indefinitely.

Both transistors are common BC547 types, which should cost you around 20c each or less. While this circuit may look fairly simple, it is more difficult than it looks to figure out how it works.

The difficulty with the circuit lies in the fact that there are really two parts to it, and it is impossible to figure out which part — that of Q1 or that of Q2 — will switch on first. In practice, all you need to remember is that when one transistor is on, the other is off; and when each transistor is on, its output voltage is *low*, while and when it is off, the output voltage is *high*.

It's not necessary to know which section switches on first — this ultimately depends on which of the two 0.1uF capacitors charges up first. Let's assume capacitor C2 is charged up before C1. What happens here is that at some point, there is enough charge to turn on one of the transistors; and because of the cross-coupled arrangement, one transistor turns on and the other is forced off.

C2 charging up first means that transistor Q1 switches on and Q2 is forced off. The reason for this is that when Q1 switches on, the Q2-base side of capacitor C1 is pulled below 0V! Now this may sound impossible, but it happens because capacitors cannot instantly get rid of or change the charge that is stored inside. So if one side of the capacitor drops from 5V down to 0V, the other side must go from 0 to -5V.

This well and truly forces Q2 off; but C1 now begins to charge up in the reverse direction until it reaches 0.7V, the limit forced upon it by the base-emitter junction voltage of Q2. Transistor Q2 now switches on, and its collector voltage drops from 5V down to 0V.

Capacitor C2 is now forced to go from 0.7V down to -4.3V (a 5V drop) which forces Q1 off. But C2 now also charges back up, until it reaches 0.7V when Q1 switches back on. The process then continues on, cycling back and forth until the power is removed.

The frequency of this circuit is dependent upon the two RC networks, and providing both the resistors (R1, R2) and both capacitors (C1, C2) have the same value, the frequency is determined roughly by the following equation:

F = 1 / (R x C)

where F is the frequency in Hz, R is the resistance of R1 or R2 in ohms and C is the capacitance of C1 or C2 in Farads. The output is a square wave with both sets of components having equal values.

The output signal is taken from the collector of transistor Q2 via a 1uF DC isolating capacitor and a 10kΩ load resistor. The other interesting aspect of this circuit is that and opposite-polarity signal is available from the collector of transistor Q1, which can be very handy and something that we'll use in a future issue.

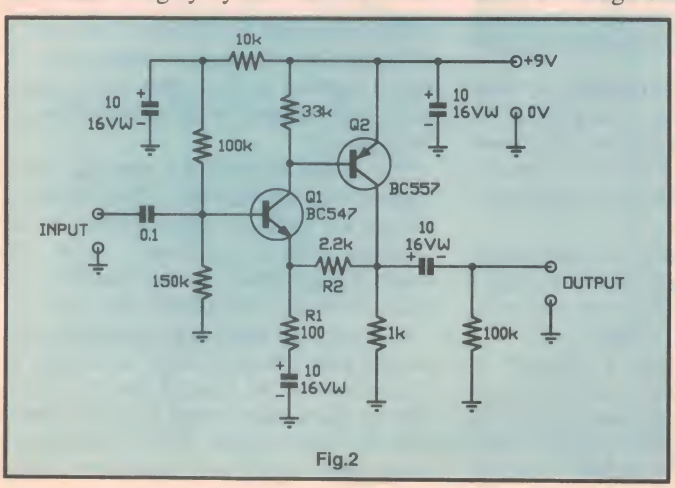


Fig.2

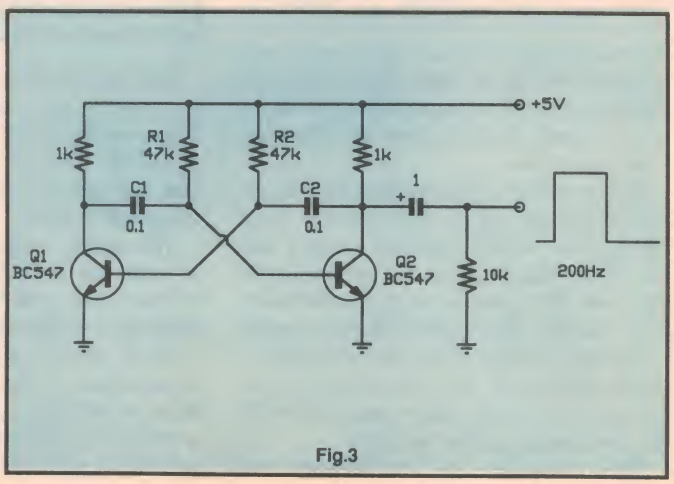


Fig.3

If you remember back to last month's column, we came up with a simple voltage-controlled volume control using a couple of series diodes. If we remove the DC volume pot and replace it with our newly created square wave oscillator, we can make a very crude 'Robot Voice' circuit as shown in Fig.4.

The audio signal, either from a tape source or from a microphone preamplifier, is fed into the circuit via a 0.1uF coupling capacitor. While the collector of Q2 is low, both diodes are off and the audio signal passes through the circuit as if nothing happened. But when the collector voltage rises to 5V, both diodes conduct and the audio signal is shunted to ground and the output goes silent.

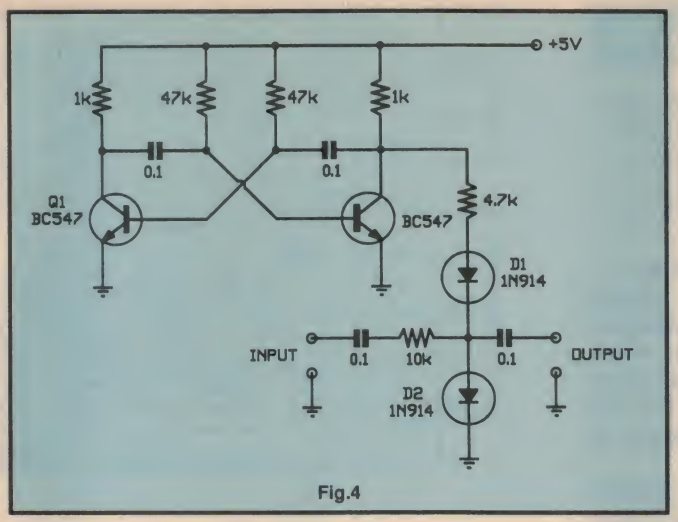


Fig.4

By switching the audio off and on like this at 200 times a second, the effect is to chop the sound up, and this chopping action produces a beat frequency in the audio at 200Hz. It's this beat frequency which gives the audio that 'robotic' flavour. All you need to do is connect the audio output to a small power amplifier to hear the result.

There is plenty of room for experimenting with this circuit, particularly with the frequency of the oscillator. Try dropping the 0.1uF capacitors down to 0.047uF (47nF) and see what results you get. What you should find is that the beat frequency rises to around 400Hz.

This is a good example of how you can join these little 'building block' circuits together, to create something different. In fact, that's all electronics really is — working out new arrangements for common circuit elements.

Current source

Our last circuit for this month moves away from the audio domain and into the realms of voltage and current control. The circuit in Fig.5 is commonly called a *constant current source*, and that's because the current that flows through the collector of Q1 is 60mA, regardless of how small the load resistance is. Let's see how it works.

So far we've used the transistor as a switch and as an amplifier, but here we take advantage of the transistor's base-emitter junction voltage — which hovers around 0.6V. Another difference in this circuit is the use of a BC327 PNP transistor. It operates in essentially the same fashion as the NPN type, just 'upside down', as we'll see.

Diodes D1 and D2 are standard 1N914/1N4148 types wired in series, with a 330Ω current-limiting resistor connected to ground. Because silicon diodes develop a fixed 0.6V drop across them, we know that the voltage at the junction of D2 and the 330Ω resistor will be 7.8V (i.e., 9V minus twice 0.6V). This junction is also connected to the base of the PNP transistor Q1, and now the transistor's base-emitter junction comes into play.

Because we know that the B-E junction voltage is always 0.6V, the emitter of Q1 is 0.6V *higher* than its base. And as the base is at 7.8V, this makes the emitter voltage 8.4V. We therefore have 0.6V across the 10Ω emitter resistor.

With most small signal transistors, you can take it as a good rule of thumb that the collector current is equal to the emitter current.

Now while this depends on factors such as the base current flow and the gain of the transistor, these factors play on a tiny part in high gain transistors such as the BC5XX and BC3XX types.

Since we have a fixed resistance and voltage determining the transistor's emitter current, we therefore have a fixed current flow through the collector as well, regardless of how small the collector load is. In practice, there is a limit to how low you can go, with the load resistance between collector and ground. But this is more to do with the power dissipated by the transistor than the excessive current flow. With the transistor turned fully on, we can assume that there is no voltage drop between the emitter and collector and that we have a maximum voltage of 8.4V at the collector.

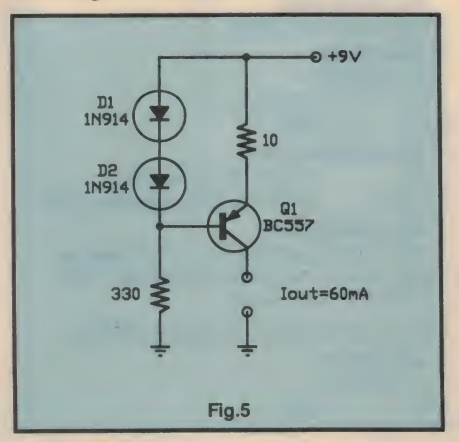


Fig.5

Now of course we can put a 1kΩ resistor between the collector and ground and the current flow will only be 8.4V/1000 or 8.4mA. But the circuit is designed to feed a constant current into a low impedance, which it does very well.

This is pretty much the only thing you need to consider when using constant current sources in basic circuits — don't load them up with too high an impedance or you'll drop too much voltage across the load, and the transistor won't be able to control the current.

An example of where this circuit can be used is as a simple NiCad battery charger. NiCad cells are best recharged using a constant current source. In fact, you could easily connect your 1.2V 'AA', 'C' or 'D' size cell between the collector and ground and it will eventually charge up. In fact, there have been quite a few projects in *Electronics Australia* that have used a circuit such as this, as the basis of a full blown multi-cell charger.

You can easily modify this circuit, particularly the amount of current the circuit can provide, by working out the following equation:

Iout = 0.6V/Rx

where Iout is the constant current in amps and Rx is the value of the emitter resistor. If we change Rx to 56 ohms, the current drops back to just over 10mA and we can now easily and safely charge up 7.2V transistor batteries. The only thing you need to worry about with a circuit as simple as this is that you don't overcharge the batteries.

A fair proportion of circuits using this approach also incorporate a timer, which automatically switches off the circuit after 15 or so hours. We will pick up this idea in a later issue.

Well, that's enough for this month. Next month, we'll continue with our look at transistor circuits with some common and some not so common designs.

(Darren Yates is Chief Engineering Officer with R.A.T. Electronics, of P.O. Box 641, Penrith 2750.) ❖

NOTES AND ERRATA

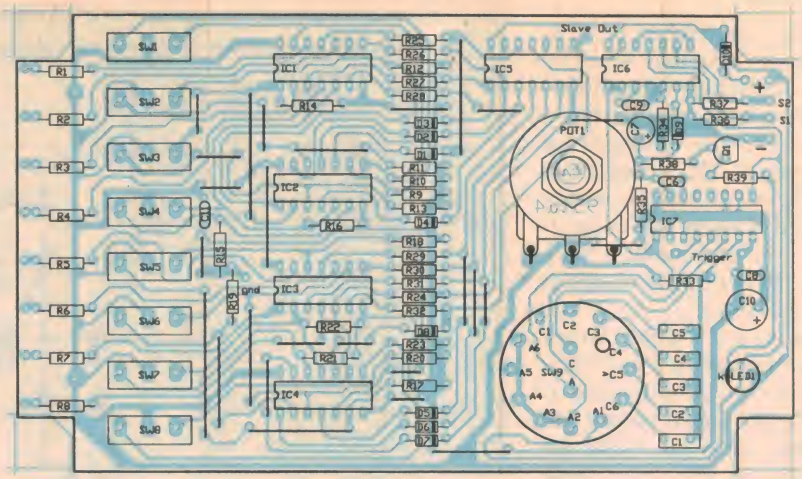
Playmaster 300W subwoofer amp (April 1995): The amp module's schematic on page 61 shows D4 connected the wrong way around — it's anode should face C16. The PCB overlay in the May issue is correct.

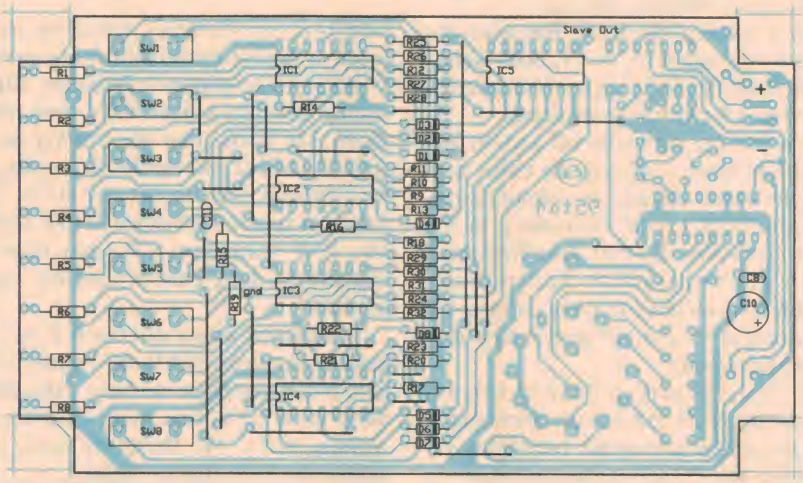
Experimenting with Electronics — Sounds on board (April 1995): Due to an unfortunate glitch in our production system, all of the parts lists were omitted, along with the information on kit availability. We apologise for this error, and the missing information is shown below.

Digital Trigger Adapter for Scopes (April 1995): The PCB overlay diagrams on page 85 were printed incorrectly, with the component outline information not reproduced at all. The diagrams on the right show (hopefully!) the overlays as they should have been printed. Our apologies for this problem, even though not of our making.

Roulette Wheel (April 1995): The PCB overlay diagram on page 50 was again printed incorrectly, with the component outline information missing. As before, the diagram is hopefully reproduced correctly on the facing page.

EA's Reader Information Service BBS: We have now installed a new Dynalink 1428VQE high speed modem, able to operate at speeds up to 19,200b/s.





PARTS LIST

Train sounds (SG1)

Resistors

All 1/4W, 5%

R1	150k
R2	330 ohm

Capacitors

C1	0.1uF mono

Semiconductors

Q1	BC547 NPN transistor
COB	train sound generator SG1

Miscellaneous

four x N/O pushbuttons; 8 ohm speaker; strip board or equivalent to accept COB PCB and components.

16-tunes (SG3)

Resistors

All 1/4W, 5%

R1	390k

Capacitors

C1,2	10uF 16V electrolytic
C3	0.1uF mono

Semiconductors

Q1	BC547 NPN transistor
COB	16-tune sound generator SG3
LED1	5mm LED

Miscellaneous

one N/O pushbutton; 8 ohm speaker; strip board or equivalent to accept COB PCB and components.

Ding-dong sound (SG5)

Resistors

All 1/4W, 5%

R1	470k
R2	150k
R3	1M
R4	330k

Semiconductors

Q1	BC557 PNP transistor
Q2	BC547 NPN transistor
COB	ding-dong sound generator (SG5)

Miscellaneous

one N/O pushbutton; 8 ohm speaker; strip board or equivalent to accept COB PCB and components.

Phone sounds (SG2)

Resistors

All 1/4W, 5%

R1	100 ohm
R2	330k

Semiconductors

Q1	BC547 NPN transistor
COB	phone sounds generator SG2

Miscellaneous

eight x N/O pushbuttons; 8 ohm speaker; strip board or equivalent to accept COB PCB and components.

Gun and siren sounds (SG4)

Resistors

All 1/4W, 5%

R1	330k

Semiconductors

Q1	BC547 NPN transistor
COB	gun and siren sound generator SG4
LED1,2	5mm LED

Miscellaneous

N/O pushbuttons as required; 8 ohm speaker; strip board or equivalent to accept COB PCB and components.

Getting COBs and COB kits

Kits of parts for the COB projects described in this article are available from:

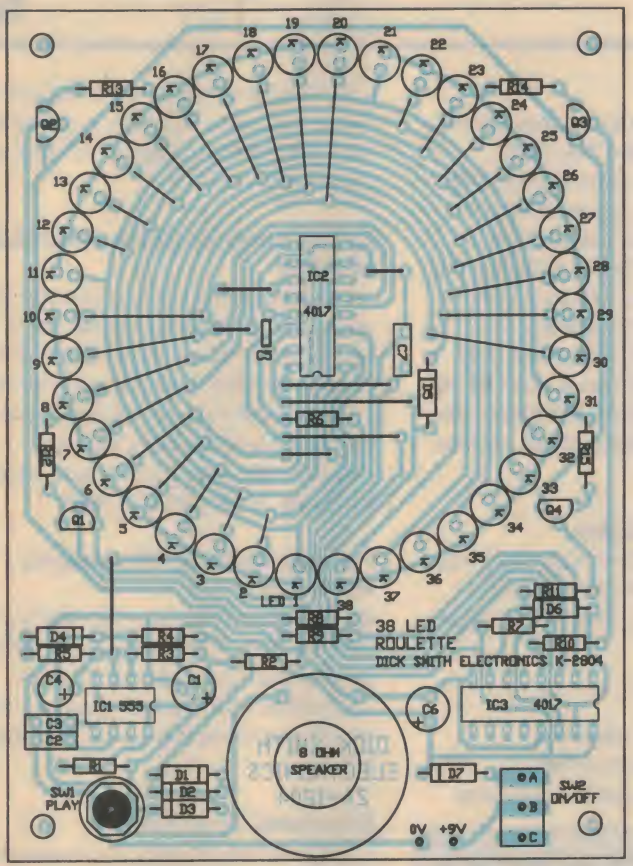
Alpine Technologies
PO Box 934,
Mt Waverley 3149.
Fax/phone (03) 751 1989.

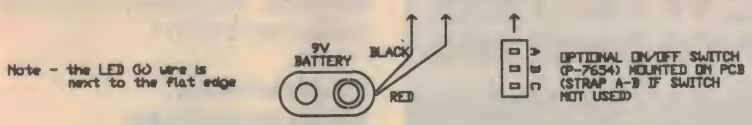
Kits for SG1 and SG2 cost $6.95; for SG3 and SG4, $6.25; and for SG5 $5, including postage. Kits also include documentation, speaker and battery holder, but no batteries.

Individual sound generator COBs are also available from:

Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.

The SG1 and SG2 sound generator COBs cost $3, while those for SG2, SG4 and SG5 cost $2.50.





PC-Based DSO Adaptor Mk2 (May-July 1994): David Jones, of Tronnort Technology has suggested the following modifications, to improve performance of this project.

1. If triggering is unstable in START mode, try adding a bypass capacitor of 100 - 220pF across R28.

2. For improved triggering stability in both START and STOP modes, replace switch S6 with a DPDT type and wire one pole as shown in the original schematic. Then remove the underboard link between pin 15 of J2 wire and pin 8 of U9b, and connect it instead between pin 15 of J2 and the second pole of S6. Now wire pin 8 of U9b to the STOP side of S6b, and connect pin 1 of U10a to the START side of S6b.

3. To eliminate any nonlinearity near full scale vertical delection, replace R35 with a wire link. This prevents R35 from disturbing the gain of U8b, at higher output levels.

4. To prevent erratic address incrementing by the computer, especially in STOP mode, bypass pin 13 of U10d to ground with a 47pF capacitor.

David Jones has also produced a new version of his DSOA software, Version 3.3a. From V3.2 an upgrade costs $10, or from earlier versions $15 — including packing and postage. Send orders to Tronnort Technology, 12 Copeland Road, Lethbridge Park 2770.

Automotive Electronics (April 1995): On page 94 the 'No.1 ignition triggering probe' is described as coupling to spark plug leads capacitively. In fact, these probes employ inductive coupling.

Inside the probe is about ten turns of fine copper wire wound around a ferrite'C' core, which mates with a ferrite 'I' core inside the hinged part of the probe. When the probe is clamped over a high voltage lead, the probe thus acts as a current transformer.

MARKETPLACE

FOR SALE

Eprom & Sram Emulator:
2K x 8 to 64K x 8. Download and verify Program via standard PC printer port. Supports Binary, Intel and Motorola hex formats, including Binary Edit. More information Contact Quick Link Engineering P/L, 472 Glenhuntly Rd Elsternwick Vic 3185 Ph: (03) 532 8775 (03) 532 8355.

New Sprinkler controller kits:
RAIN BRAIN version uses 'C8 and switch mode supply. Features galore!! Contact Mantis Micro Products, 38 Garnet ST. Niddrie, 3042 Phone/Fax (03) 337 1917.

Tiny Video Cameras:
from $199 MATCHBOX SIZE PCB MODULES from 32 x 32 x 15mm with lens. 25 types. Optional lenses, C lens mounts, cases & technical manuals. See review pg138 EA Nov '94. Allthings Ph/Fax (09) 349 9413.

Amidon Ferromagnetic Cores:
For all RF applications. Send business size SASE for data/price to RJ&US Imports, Box 431, Kiama NSW 2533. Agencies at Geoff Wood Electronics, Sydney; Webb Electronics, Albury; Assoc TV Service, Hobart; Truscotts Electronic World, Melbourne and Mildura; Alpha Tango Products, Perth.

Network Software:
Little Big LAN uses Serial, Parallel, Arcnet or Ethernet to share files and printers on your PC's. DOS and Windows compatible. $105 per network. All prices + postage. GRANTRONICS, PO Box 275, Wentworthville. 2145. Ph/Fax (02) 631 1236.

"The homebuilt dynamo":
(construction plans), brushless electric generator, 1000 watt DC at 740 RPM. A$85 postpaid airmail from Al Forbes, Box 3919-EA, Auckland, New Zealand. phone 0011 649 818 8967 anytime. Philips Ferroxdure rotor magnets (3700 gauss) kit now available cut to size and magnetised. Fax: 64 9 818 8890.

C Compilers:
Everything you need to develop C and ASM software for 68HC08, 6809, 68HC11, 68HC16, 8051/52, 8080/85, 8086 or 8096: $150.00 each. Macro Cross Assemblers for these CPUs + 6800/01/03/05 and 6502: $150 for the set. Debug monitors: $75 for the 6 CPU's. All compilers, XASMs and monitors: $450. 8051/52 or 80C320 Simulator (fast): $75. Demo disk: $5. All prices + postage. GRANTRONICS, PO Box 275, Wentworthville. 2145. Ph/Fax (02) 631 1236.

UHF hand held radios:
Shinwa SH404Kg Band 400-520 MHz, complete with battery (Nicad) and battery processor $150.00 each. Phone (077) 211 935.

Unusual books:
Electronic Devices, Fireworks, Locksmithing, Radar Invisibility, Surveillance, Self Protection, Unusual Chemistry and More. For a complete catalogue, send 95 cents in stamps to: VECTOR PRESS, Dept E, PO Box 434 Brighton SA 5048.

Old editions of Radio & Hobbies and EA:
1939-1949 42 issues, 1950-1959 30 issues, 1960-1969 51 issues 1970-1979 80 issues. Includes: April 1939 Vol 1 No. 1. 1947 & 1950 Shortwave Handbooks, 1975 & 1976 Yearbooks. Send SAE or call for a complete list. Offers to: Stephen Stebbing 8/11 Chapel St, St Kilda, Vic 3182. (03) 510 5987.

I've got 80 EPROM emulator PCBs left:
Normal price $30, now $10! 8031's $2. P&P $5. This PCB can be used for 8051 development projects too. See EA Jan/Feb 92. Tantau Australia P.O. Box 1232 Lane Cove 2066. A.H. (02) 878 4715.

Swansea, Tasmania:
3 bedroom house with T.V. & electronics workshop. Also amateur radio antennas. Details, 002 578 471.

Sinadder meter, Vicom model PLM:
with books, cost $1100 sell $300. Solder in tweeters for surface mounted devices includes transformer, accessories. New in box. Never used $150. Ring (03) 354 9991. Joe, PO Box 70, Pascoe Vale South, 3044.

Technology Breakthrough:
A $20 Programmer Kit for one of the newest, fastest, low power single chip EEPROM Micros available. The $15 PIC16C84 can be it's own downloader development system as it will re-program 1 Meg times, each time in 10 seconds. A $2 coin for my PROMO disk. Don McKenzie, 29 Ellesmere Cres, Tullamarine 3043; Ph (03) 338 6286.

NEW RATES
EFFECTIVE AUGUST 1995

ADVERTISING RATES FOR THIS PAGE

SMALL ADS:
The minimum acceptable size of two centimetres x one column costs only $50. Other sizes up to a maximum of 10 centimetres are rated at $30 per centimetre.

CLASSIFIEDS:
$6 for 40 letters. Just count the letters, divide by 40, and multiply by $6.
ROUND UP TO THE NEAREST MULTIPLE OF $6
MINIMUM CHARGE $12.

CLOSING DATE:
Ads may be accepted up to the 10th of the month, two months prior to issue date.

PAYMENT:
Payment by cheque or money order only, plus your name and address, should be sent with your advertisement, to:

THE ADVERTISING PRODUCTION MANAGER
ELECTRONICS AUSTRALIA,
P.O. BOX 199,
ALEXANDRIA, NSW 2015

Engraved Panels:
Antique or modern look. Any size, your design. Write or phone for a free sample. COMPUGRAV Box 941 St. Marys 2760. Ph. or Fax (02) 623 3598.

MicroCraft Presents:
Dunfield (DDS) products are now available in Australia. Micro C, the affordable 'C' compiler for embedded applications. Versions for 8051/52, 8086. 8096, 68HC08, 6809, 68HC11 or 68HC16 $149.95 each + $3 p&h • Now on special is the SDK a package of ALL the DDS 'C' compilers for $410 + $6 p&h (save $139) • EMILY52 is a PC based 8051/52 high speed simulator $69.95 + $3 p&h • DDS demo disks $7 + $3 p&h • VHS VIDEO from the USA (PAL) 'CNC X-Y-Z using car alternators' (uses alternators as cheap power stepper motors!) $49.95 + $6 p&h (includes diagrams) • Device programming EPROMs /PALs etc from $1.50 (inc label). We use and recommend the HILO ALL-07 Universal Programmer • Fixed price PCB layout & photoplots. We use and recommend PROTEL For Windows EDA tools • Credit cards accepted • Call Bob for more details MICROCRAFT, PO Box 514 Concord NSW. 2137 (02) 744 5440 or FAX (02) 744 9280.

Printed Circuit Board Manufacture
We manufacture high quality PCBs at prices so low, that it's not worth making yourself!
INSTANT PCB's
P O Box 448 Avalon 2107
Ph (02) 974 1189 Fax (02) 974 5491

CHRISTIAN BLIND MISSION
Restoring sight to the blind
1245 Burke Rd.,
Kew 3101

R.C.S. RADIO PTY. LTD.
Established in 1933, RCS Radio is the only company which manufactures and sells every PCB and front panel published in Electronics Australia and ETI/SC.
651 Forest Road, Bexley, NSW 2207
Ring (02) 587 3491 for instant prices.

SERVICES

Kit assembly & repair:
Low rates. Contact Autronics on phone (08) 294 8591.

KIT REPAIRS - R & D, prototyping, repairs to electronic equipment, all kits repaired
CAMPAD ELECTRONICS
26 KEITH STREET CAPALABA, Q. 4157
Phone (07) 245 2008

POSITIONS VACANT

Medical Electronics Company requires
P.C. control software designer
with analog/digital design background.
Please send resume to
4 Clarke St Guilford NSW 2161

WANTED

Any early valve hifi:
Quad, Leak Garrard 301/401, SME, Ortofon, KT66, KT88, 300B or similar. Cash paid (074) 491 601.

Magnavox 8-30 Speakers:
new or near new. Also Ferguson OPM1-A output transformers, A&R 1932-175mA power transformers. Contact Rick via pager 016 378 813 (local call from anywhere).

your computer

Your computer is Australia's only computer magazine written for small business and home users.

Our editorial team is locally written and is slanted with a 'hands on' approach for those who believe in PCs as a tool to increase business efficiency and productivity.

On sale at newsagents or call 008 800 933

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

June 1945

Miniature recorder: A recording set the size of a folding camera, completely built-in save for a microphone on the cord, has been developed by a Chicago inventor.

Powered by a battery receiver and destined for postwar civilian use, it weighs only three pounds. It picks up anything the human ear can hear. Radio and newspaper reporters are the most likely users of this midget set.

Pulse-time modulation: Development of a system of pulse time modulation application to wire and radio, including broadcasting and television sound channels, was disclosed at a meeting of the Insitutute of Radio Engineers by E. Labin and E.M. Deloraine, of Federal Telephone and Radio Laboratories, associate of the International Telephone and Telegraph Corporation. It consists essentially in transmitting information by pulsing of constant amplitude and duration.

Instantaneous amplitude of voice is translated into a variation of time intervals of successive pulses, the rate of variation corresponding to instantaneous frequency of signal.

June 1970

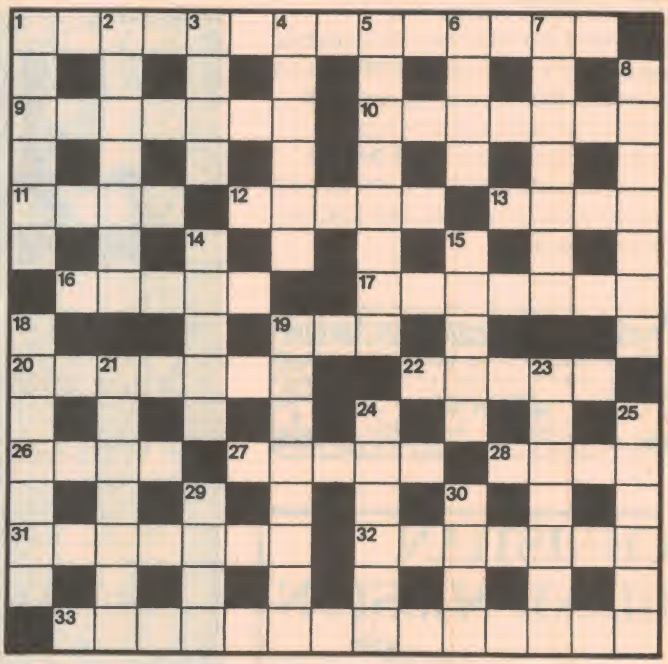
Computer for new university: The James Cook University of North Queensland, which became autonomous on April 20, has placed an order for a large scale PDP-10 time sharing computer to be installed in October this year. The computer, to be supplied by Digital Equipment Australia Pty Ltd, will simultaneously provide multi-language terminal facilities with multi-programmed batch operation and, if required, on-line control of laboratory experiments. Research, administration and teaching applications will constitute the bulk of the computing workload, but a service will also be provided for outside users.

Explorer 1 returns: The first US satellite in space, Explorer 1, re-entered the earth's atmosphere over the South Pacific on March 31 this year. It was launched on January 31, 1958 on a Jupiter-C rocket from Cape Canaveral, Fla. Data from this first flight established the presence of the Van Allen radiation belts around the earth.

Canadian transmitter: Canada's first high power UHF television transmitter will be installed in Toronto jointly by the Canadian Broadcasting Corporation and Marconi this year.

The contract, worth $200,000, was awarded to the Marconi Broadcasting Division through the agency of the Canadian Marconi Company. The 55KW transmitter will be owned and operated by CBC, and leased to the Ontario Department of Education. The Department will use the transmitter for the country's first full time educational television channel to be inaugurated on September 1, this year. ❖

EA CROSSWORD



ACROSS

1. One determined to find and fix faults. (14)
9. Bands of frequencies. (7)
10. Return of spacecraft to Earth's atmosphere. (2-5)
11. Qualifying test. (4)
12. Production errors. (5)
13. The brain produces —— waves of about 50Hz. (4)
16. Retransmit. (5)
17. Satellite launchers. (7)
19. Brand of consumer electronics. (3)
20. Voice of upper register. (7)
22. Short electromagnetic burst. (5)
26. Service provided by TV station. (4)
27. Former radio pulsed navigation system. (5)
28. Video programmer, the G- ——. (4)
31. Nobel prizewinner, Guglielmo ——. (7)
32. Type of motor. (7)
33. Brand of computer. (5,9)

DOWN

1. Checked operation. (6)
2. Function. (7)
3. Unit of information. (4)
5. Physical units of computer system. (8)
6. Term often used in older style radio telephony. (4)
7. Most remote; utmost. (7)
8. Junction at which nerve impulses cross. (7)
14. Unit of capacitance. (5)
15. Part of an analogue meter. (5)
18. Transverse surface wave. (8)
19. Radioactive element. (8)
21. Initiate energy to a circuit. (5,2)
23. Constellation with red super giant Antares. (7)
24. Astronomical length. (6)
25. Examine items in computer data. (6)
29. Sound of acoustic feedback. (4)
30. Les ——, radio industry pioneer associated with Stromberg-Carlson. (4)

SOLUTION FOR MAY 1995

E	L	E	C	T	R	O	N	I	C	S		S	B	S
C	L	I				N	O		E		T			
K	E	E	P	E	R	S		V	I	N	T	A	G	E
E		C		S		C		E		Y		L		A
R	A	T	E		T	R	U	N	K		M	A	I	L
T		R		H		O		T		S		N		T
	M	O	N	O	C	L	E		S	W	I	T	C	H
B			U		L		B		E					Y
A	M	P	E	R	E		M	A	G	E	N	T	A	
R		E		S		D		C		P		E		S
G	A	N	G		D	I	S	K	S		S	L	O	T
R		T		F		V		U		C		S		O
A	N	I	L	I	N	E		P	L	O	T	T	E	R
P		U		L		R				M		R		E
H	U	M		M	O	T	H	E	R	B	O	A	R	D

Electronics Australia's

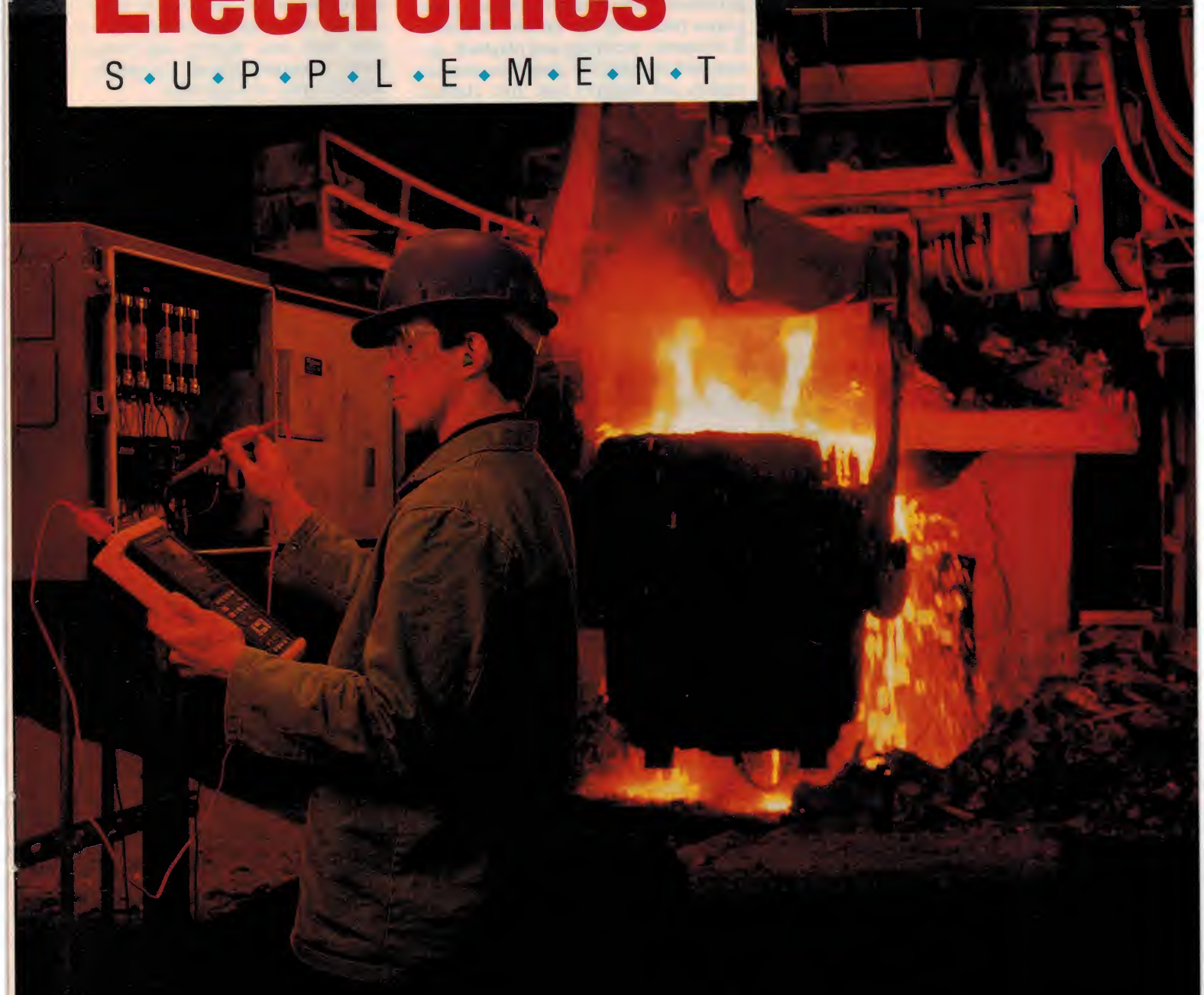
Professional Electronics

S • U • P • P • L • E • M • E • N • T

NEW SMART CARD FOR NSW PUBLIC TRANSPORT USERS

GRIFFITH UNI TO SCAN IN HISTORIC PHOTOGRAPHS

REVIEW OF HP'S NEW 54620A LOGIC ANALYSER



FLUKE'S NEW & ENHANCED 'SERIES II' SCOPEMETERS OFFER AUTOSET BUTTON, HAVE INBUILT FULL ON-LINE HELP SYSTEM...

NEWS HIGHLIGHTS

NORTH QUEENSLAND RADIO CONVENTION

The Townsville Amateur Radio Club Inc will be running this year's North Queensland Amateur Radio Convention at the Western Campus of James Cook University, in Townsville, on September 16 and 17.

Registration and further information can be obtained from The Townsville Amateur Radio Club at PO Box 5744, Townsville MC, Queensland 4810.

CYBEC'S 'VET' IS OZ LEADER

Melbourne-based firm Cybec, specialist in antiviral computer software, claims that its well-known package *Vet* is now the Australian leader in this technology. The package is now used by a very wide range of universities, TAFE colleges, schools, research bodies, Government departments and commercial organisations large and small, not only within Australia but also overseas (including the UK).

Developed originally by Cybec founder Roger Riordan, *Vet* has been enhanced many times since it was first released, and is regularly updated to ensure that it can deal with newly developed virus technology.

The latest version, V8.1, is Windows and OS/2 compatible and gives on-screen help and virus information. It can be configured to provide automatic protection as well as manual scanning, and is not only one of the fastest virus scanners, but also an extremely thorough one. The fact that *Vet* is locally developed also ensures that Cybec can offer fast and efficient support, for Australian users.

Incidentally, *Electronics Australia* is itself a proud user of *Vet*, which we use to check all incoming files — including all files made available via our Reader Information Service Bulletin Board System.

SHOPPING COMPLEX BUYS DISKLAVIERS

Sydney's restored Queen Victoria Building (QVB) shopping complex has purchased three Yamaha concert grand pianos fitted with the Yamaha Disklavier II electronic recording and playback system, and is using the pianos to entertain visitors and shoppers with 'live' classical music. The pianos are located on different levels in the complex but are interlinked via the MIDI system, allowing a single player to play all three simultaneously — or multiple players to perform together.

The Yamaha Disklavier II system is essentially a modern version of the 'reproducing pianos' that were popular earlier this century, but uses digital electronics to provide enhanced recording and playback of all aspects of a pianist's performance.

Shown here is one of the three Yamaha concert grand pianos used to entertain visitors and shoppers in the restored Queen Victoria Building.

Optical sensors are used to register every nuance of key and pedal movement for recording, without interfering in the least with the piano's action or 'touch'. For playback long-stroke solenoids under the rear of the keys recreate the original performance, complete with note velocity and extension. Other solenoids operate the pedals, for faithful replay of expression.

Young piano students from the NSW Conservatorium of Music, other Sydney schools and private piano teachers are being invited to perform on the pianos at regular recitals.

Also the Disklaviers are used to play recordings of performances by world famous pianists, at other times. Performances take place daily at 11.30am and 12.30pm.

1995 ATERB SCHOLARSHIPS

The Australian Telecommunications and Electronics Research Board (ATERB) has again awarded one-year postgraduate scholarships (with the possibility of extension to three years), to encourage research in the area of telecommunications. The scholarships are valued at $11,000 tax-free per year, and are awarded to students of Electrical Engineering, Computer Systems Engineering, Theoretical Physics and Telecommunications, at Australian universities.

The eight scholarship recipients for 1995, their university and their respective fields of research, are:

- Hyunsoo Cho, University of Technology, Sydney, 'Mechanisms for Supporting Quality of Services in Distributed Multimedia Applications'.
- Benjamin Eggleton, University of Sydney, 'Optical Properties of Holographically Written Bragg Gratings in Photosensitive Optical Fibre and Application in Nonlinear Optical Signal Processing'.
- Martin Evans, University of Technol-

ogy, Sydney, 'Implementation and Applications of FCMA'.

- Mark Janos, University of Sydney, 'Adaptive Photonic Signal Processing Systems for Telecommunications Networks'.
- David Lapsley, Curtin University of Technology, 'Network Performance of Access Control Protocol for ATM Networks'.
- Tanya M. Monro, University of Sydney, 'Self Written Waveguides'.
- David Rowe, University of Technology, Sydney, 'Rapid Prototyping for Service Verification via Object Orientated Visual Programming'.
- Kenneth Tan, University of Melbourne, 'Narrowband Interference Suppression in CDMA Spread-Spectrum Communications'.

ATERB is jointly sponsored by Telecom Australia, CSIRO and DSTO, who co-opt academic representatives from the universities onto the management committee.

PHILIPS WINS MAJOR PAY TV CONTRACT

BTS Broadcast Television Systems, a business unit of Philips Electronics, is to make a multi-million dollar delivery and installation of the most technologically advanced digital equipment for the production and transmission of Australia's newest pay TV channels, Australian Information Media.

The Australian Broadcasting Corporation's subsidiary Australian Information Media (AIM) has recently unveiled its two channel service, with US based Cox Communications and newspaper company John Fairfax Holdings being the main partners. Turner International's CNN and Viacom's Nickelodeon join the party as partners and programming sources.

The services, which will a include Australia's first 24 hour news channel and children's programming during the day, plus drama, documentaries and general entertainment in the evening, will begin shortly to subscribers via cable, MDS or satellite.

BTS won the contract for a total package of equipment for the service's new studio complex at Gore Hill in Sydney.

The complex will include news and current affairs studio and will feature key products from the BTS range including the LDK 10P series cameras, the DD20 production switcher, the Saturn presentation switcher, the Venus router, the Jupiter control system and the Alamar automation system.

The BTS concept is based on a total equipment integration from production to distribution. The ground-breaking, fully digital installation is totally future proof. Even the picture aspect ratio can be changed from normal 4:3 to 16:9 widescreen at the touch of a button.

120MHZ PENTIUM HAS 0.35 MICRON PROCESS

Intel has introduced a new, higher performance version of its Pentium processor. The new processor operates at 120MHz, delivers 140SPECint92 and 103SPECfp92 of performance, and is available in volume now.

The 120MHz Pentium is the first volume microprocessor to be built using 0.35 micron process technology (a micron is approximately 1/100th the diameter of a human hair). This new technology will allow the Pentium processor die to shrink to half its current size, which translates into higher performance, high reliability and lower cost products for computer users in the future.

"The rapid implementation of the 0.35 micron manufacturing technology allows us to expand the Pentium processor family at an unprecedented pace," said G. Carl Everett, senior vice president, Microprocessor Products Group.

"The 120MHz Pentium processor introduces a new level of compatible performance for mainstream desktop computers."

"New members of the Pentium processor family, including a 150MHz version, will be introduced during the year," noted Everett.

Intel's move to volume microprocessor manufacturing on a 0.35 micron process technology allows the die size to be reduced to approximately one half the size of Intel's Pentium processors built on 0.6 micron process technology (75, 90 and 100MHz) which was introduced just last year, or about one fourth the size of the original Pentium processors built on the 0.8 micron technology (60 and 66MHz) introduced in 1993.

Intel's 0.35 micron process technology is a 3.3 volt BiCMOS process that combines the energy saving features of CMOS technology and the high performance characteristics of bipolar technology. The process features four layers of metal and full use of planarisation (polishing each surface of the wafer flat before building the next layer upon it), and is built on 8" (200mm) wafers.

TELSTRA BUYS $4M IN TEK TDR'S

Tektronix has been awarded a three year contract to supply its TS100 TelScout Time Domain Reflectometers (TDR) to Telstra. The Telstra contract is estimated to be worth $4 million to Tektronix over the next three years.

The TelScout TS100 combines unprecedented ease of use, high performance, rugged packaging and competitive price with a feature set optimised for telephony. It tests both twisted pair and coaxial cables.

Unlike products that require operators to navigate through multiple menu levels as they select a range of test criteria, the one step set-up and operation of the TelScout is highly automated, requiring Telstra technicians only to identify the cable type to obtain a waveform.

GRIFFITH UNI TO SCAN HISTORIC PICS

Historical photographs held in the State Library in Brisbane should be accessible by all Queenslanders within two years, under a plan to digitise the prints and make them available on CD-ROM.

The first stage of the project, which is to investigate and evaluate available technology, is being carried out by the State Library in cooperation with the Griffiths University's School of Microelectronic Engineering Industrial Affiliates Programme (IAP).

The IAP provides industry with undergraduates in the Bachelor of Engineering in Microelectronics Engineering degree

course with an opportunity to work on important research projects with an industrial partner.

Student Steven Chamberlain will lay the groundwork for the introduction of the new system, which initially will involve about 20,000 historical photographs. Steven is responsible for investigating technology options, liaising with suppliers, evaluating systems and recommending the technology, which aims to eventually provide State-wide access to the 750,000 historic photographs in the collection.

Griffith University (IAP) is also involved in a research project to optimise Queensland's only stereolithography facility at the Queensland Manufacturing Institute. Stereolithography is a three dimensional modelling process which produces copies of 3D CAD solid or surface models in plastic.

The process uses a moving laser beam, directed by computer, to 'draw' cross sections of the model onto the surface of photo-curable liquid plastic. It can make prototypes of products and components in hours instead of the days and weeks required by traditional manufacturing processes.

The upgrading involves remote monitoring and control of the machine to ensure that the manufacturing process does not shut down suddenly in the event of a power problem, delaying production by up to several days. Instead, the computer controlled apparatus senses a power corruption, carries out a controlled shutdown, and allows manual resumption of production when power is restored.

The project, which began last year, is being continued by Griffith University student Raymond Clarke, under the IAP. Raymond is carrying out the final stages — completing the software, checking the performance of the UPS, and developing monitor software.

The IAP provides undergraduates in the Bachelor of Engineering in Microelectronic Engineering degree course with an opportunity to work on important research projects with an industrial partner.

OZ BREAKTHROUGH IN DATABASE ACCESS

Australian-owned ACEL Information Pty Ltd has leapt onto the information superhighway with CD-CONNECT, a new system which will provide instant, networkable access to massive image databases. It is the product of more than 12 months' work by a team of 10 specialists.

Students at the School of Cognitive and Computing Sciences at the University of Sussex, UK, are using this experimental robot, dubbed 'Mr Chips' to evolve new designs for robot control using neural networks. The students are studying insect behaviour to understand the mechanisms underlying intelligent activity. Mr Chips uses a lap-top PC as its 'brain'.

Combining expertise in CD-ROM technology, ISDN and advanced computer software, the ACEL team has integrated the potential of each of these technologies, thus overtaking the major multi-national information suppliers.

ACEL's members use a CD-ROM as an index to conduct all their searches. Required documents are automatically retrieved via Telecom's ISDN. ACEL believes its DC-CONNECT technology is the first commercial ISDN application for information transfer from a data provider to its hundreds of customers. As such, it represents a breakthrough for ISDN as well. According to Technical Director Richard Barber, it is impossible to transmit this kind of image data through ordinary analog phone lines at a worthwhile speed.

"Of course, we found that ISDN in itself did not solve all the problems of obtaining instant access to our large image data bases. But it provided the foundation," Mr Barber said.

The rest of the solution was in software developed by ACEL to smooth the way for users to enjoy convenient access to the information, while minimising the connect time. With ACEL's solution, information can be downloaded almost instantly to the user's computer. ACEL's software enhancements have greatly increased the speed at which ISDN works.

Further, ACEL's Windows interface makes the whole process seamless and automatic. There are no complicated login/logout procedures. The main reservoir of data will be held in ACEL's computers. An updated index CD will be supplied regularly to ACEL's customers.

"If our customers were to have all the data in CD-ROM format, it would require 60 to 70 CDs, with all the attendant problems of networking and storage," Mr Barber said. "They would need to install a jukebox which slows access time, and is prone to mechanical problems. Or, they could daisy chain dozens of CD drives, which would be terribly expensive. In short, they wouldn't get many of the benefits of electronic delivery."

ACEL plans to offer CD-CONNECT to its Australian customers during 1995 and has begun looking at export opportunities in Europe and South East Asia.

SMART CARD FOR NSW TRANSPORT

Australia's first contactless transport smart card, Transcard has been launched, enabling consumers to use the one ticket to travel on any mode of public transport — from train to bus to taxi.

Transcard also enables consumers to make small purchases using the one plastic card.

The introduction of Transcard began

VCE GIRLS STUDY AT RMIT TAFE

Royal Melbourne Institute of Technology TAFE is joining forces with Footscray Girls Secondary College to provide Year 11 and 12 VCE electronics training at RMIT's city campus. A group of Year 12 students have done some of their VCE physics work in the TAFE Department of Electronics Technology in first semester, while during second semester, around 20 Year 11 Physics students will join RMIT's electrical/electronics Associate Diploma classes for the subject 'electrical fundamentals', for half a day each week. The secondary school will conduct the assessment, in consultation with RMIT staff.

RMIT's TAFE Equal Opportunity Manager, Ms Anne Holland, said that the project will have two significant benefits. It will provide the students with access to RMIT's facilities, and it will encourage the girls to consider electronics as a career option.

"Girls are significantly under-represented in the electronics course," she said. "This project will allow them to see that RMIT is a good place to come to study. They will have a positive experience in the subject; and they will feel comfortable here, so it might encourage them to undertake further training in electronics and consider TAFE as an option for further studies."

From left: RMIT teacher Klaus Bienert, 1st year RMIT student Betty Genc, and VCE students from Footscray, Lily Wuam and Suzie Todovoska.

The Head of the TAFE Department of Electronics Technology, Mr Ian Hood, said that the project is part of a strategy to increase the number of female applicants into the electronics course. "People are more likely to choose subjects they have some knowledge of," he said.

Mr Hood and Ms Holland addressed Year 10, 11 and 12 students from the Footscray school last year. As a result, two have begun the Associate Diploma of Electronics this year.

For course information, call (03) 660 4425.

with a three month trial in Sydney's west, to be followed by a national roll out from July 1995. Transcard's Chairman, Mr Reg Kermode, said that Transcard will make public transport more convenient and accessible.

"Transcard goes one step further than other smart cards. It not only offers a ticketing and payment system on the one anonymous card, but it also uses contactless technology."

There are no slots or PINs with Transcard. A microchip and antennae in a standard sized plastic card 'talks' via radio signals to a card reader, without physical contact. Consumers simply tap the card reader to pay. The Transcard inbuilt microchip processes and stores information, allowing the consumer to buy and store tickets as well as load and spend electronic cash (like a reusable phone card) for travel and small purchases such as newspapers or fast food.

When the balance runs low, Transcard can be topped up by using either cash, credit or EFTPOS, at any Transcard agency which includes newsagencies and other outlets.

NEWS BRIEFS

- ***Cray Communications*** has announced the appointment of Mr Greg Dyer to the newly created post of Logistics Manager for Asia Pacific.
- The 11th Hong Kong International Computer Expo Systems show ***Computer '95*** will be held at the Hong Kong Convention and Exhibition Centre from May 24-27, 1995. For more information contact Business & Industrial Trade Fairs, 18/F First Bank Centre, 56 Gloucester Road, Wanchai, Hong Kong, phone (852) 2865 2633.
- ***Optical Systems Design*** has moved to 7/1 Vuko Place, Warriewood, Sydney 2102. The PO box, phone and fax numbers remain the same.
- ***Zatek Australia*** has been appointed representative and distributor for CTS Corporation, manufacturer of optical data links.
- Mr Gil Thew has been appointed Managing Director of ***SunSoft Australia***, a subsidiary of Sun Microsystems.
- The 12th Thai ***Computer and Communication Marketplace*** will be held in the Queen Sirikit National Convention Centre, Thailand, November 23-26, 1995. For more information, contact Thai Trade Fairs 822/1 Rama VI Road, Phyathai, Bangkok 10400, phone (662) 215 6555. ❖

SMPTE '95 FOR DARLING HARBOUR

The SMPTE '95 Exhibition and Conference is to be held at Darling Harbour from July 3 - 6, 1995. Leading innovators in the sound and picture industries from around the world will be showcasing the latest in new equipment in film and television engineering. Exhibitors include Sony Australia, GEC Video Systems Division, Amtech, Techtel, Amber and Hagemeyer.

The SMPTE '95 Exhibition will feature new product and equipment launches, including the release of the new Australian production music library, The Soundtrax Music Library from the Nightlife Music Group.

To commemorate the launch, the company is also giving away a Ken Duncan limited edition print.

1995 is the first SMPTE exhibition and conference to follow the rescheduling of the bi-annual event to odd years, better positioning SMPTE within the international programme of events.

A different style of conference will support this year's exhibition. The conference programme will be structured around six half day seminars. ❖

Mini Construction project:

PC-based 68705K1 Programmer

This low cost project has all you need to get into programming the Motorola 68HC705K1 microcontroller. The project includes all the hardware and software, yet it costs around $70. Now you've no excuse!

by PETER PHILLIPS

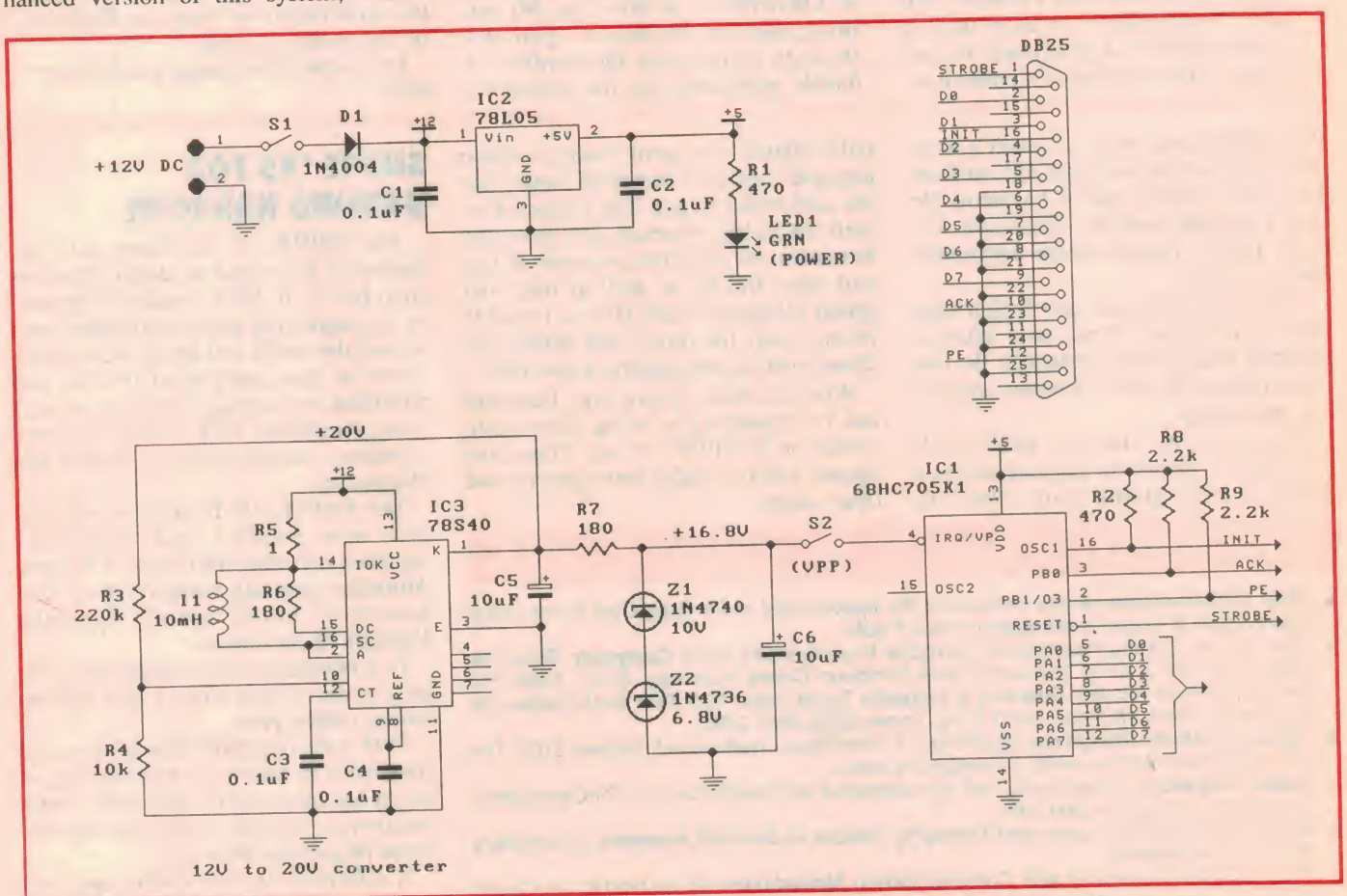
This very simple project comes from Robert Priestly, the designer of the Motorola 68705 microcontroller development system presented in *EA* for March 1993. This previous system included a versatile software package and a programmer board to accept a range of 68705 microcontrollers.

Then in July '94, we reviewed an enhanced version of this system, which included additions to the software and the capacity to program a wider range of Motorola microcontrollers. This new system has won widespread acceptance, and is being continually upgraded.

However, while a system that can program a range of microcontrollers is versatile, it's often overkill if you only want to program one type. And that's where this 'mini' system comes in. It's intended for the 68HC705K1 series only, which is why the programmer PCB is so small. So, first let's take a brief look at the 'K1 microcontroller, as the whole project is based around this device.

The 68HC705K1

Like all members of the Motorola microcontroller family, the 68HC705K1



The programming voltage (Vpp) is developed by the circuit around IC3. The board interfaces to an IBM compatible computer via its parallel port, and the programming process is controlled by the computer software.

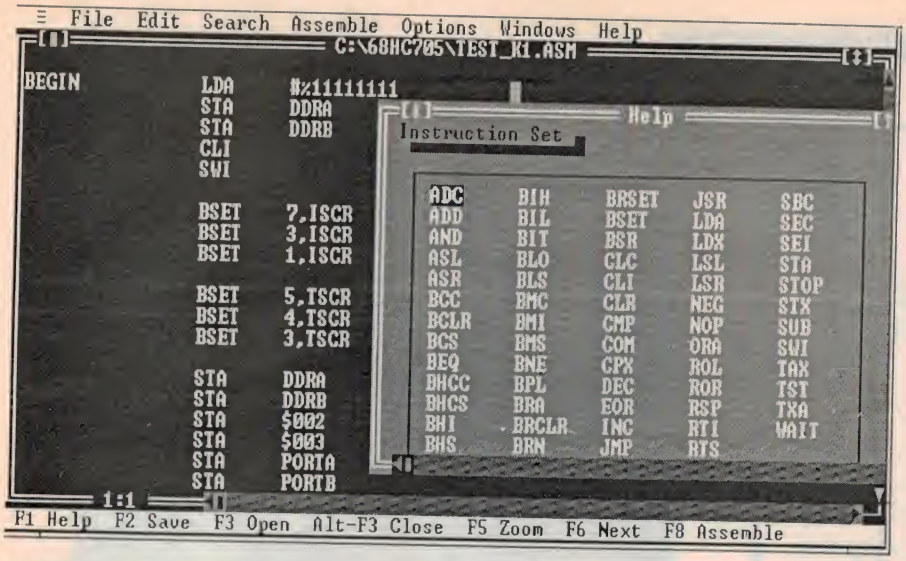


Fig.1: This shot shows the editor screen, with a superimposed window with the instruction set of the 'K1 microcontroller. The complete data on the 'K1 is included in the software package.

is available in two versions: one with one-time programmable read-only memory (OTPROM) and the other with erasable PROM (EPROM) memory. The latter is more expensive at around $40 to $50, but is essential for development purposes, as it can be repeatedly erased for 'another try'.

The OTPROM version however is much cheaper, at around $6 to $8. But because you only get 'one go' at programming it, this version is programmed only when your software has been fully developed. So ideally, you need one EPROM version to test the software you're developing, and an OTPROM version for each declared function you develop.

The 'K1 is a 16-pin microcontroller, which makes it unique in the Motorola family as all other devices have at least 20 pins. It has 504 bytes of EPROM, 32 buytes of RAM and 10 bi-directional I/O pins in two I/O ports. Port A has eight I/O lines and port B has two. Four of the I/O lines can sink up to 8mA, to drive a LED or similar. Four more lines can be programmed as maskable interrupts.

The 'K1 features static operation, which means there's no minimum clock speed. The clock can be anything from a single-stepped switch (debounced, of course) up to a 4MHz crystal controlled oscillator. The chip has its own on-board clock oscillator, which can be configured as either a crystal or an RC oscillator.

The system

As with the previous systems, there are two parts: a build-your-own programmer board (as in the photo), and IBM compatible computer software supplied on a disk with the kit. The board plugs into the parallel port of the computer, via a DB25 plug on the PCB. The only other external connection is a +12V DC supply, from either a DC plugpack or any external DC supply.

To program a 'K1 microcontroller, you simply insert it in the socket on the programmer board, and press a few computer keys to make the software do the rest. We'll describe this PCB in more detail later, but first a look at the software that comes with the system.

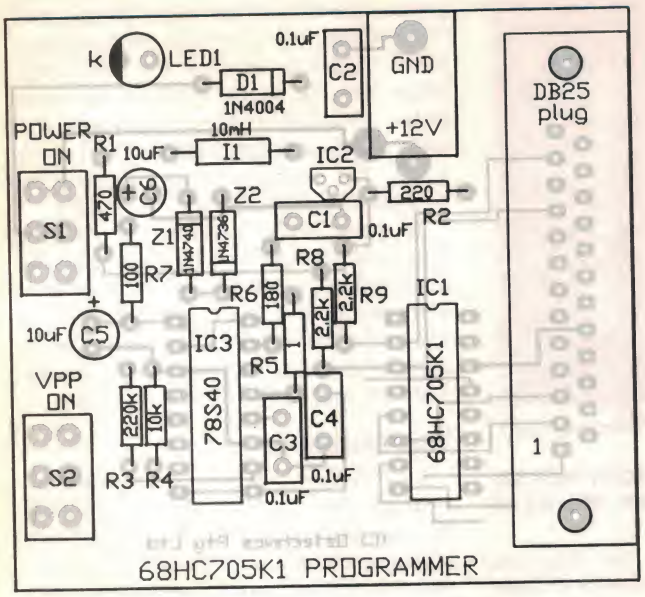
The software

Like Robert's previous development systems, the software that comes with this one includes the Motorola freeware cross-assembler, a software simulator and the software to drive the programmer PCB.

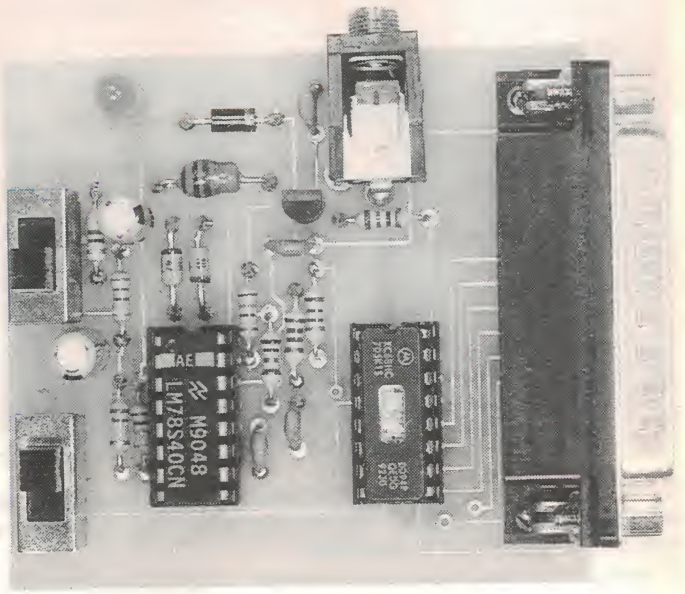
We won't describe this software here, as it's been covered in detail in the previous articles. For more information, refer to either the July '94 or the March '93 editions of EA.

But unlike the previous versions, this new package also has an on-line text editor that — believe it or not — includes the complete 'K1 data manual. That's right, you get all the instructions, specifications and so on, right at your finger tips, and right where you most need it. The text editor is used to write the source code, which is then passed to the cross-assembler where it's assembled into hexadecimal code.

PC-based 68705K1 programmer



Here's the layout diagram of the PCB. The board is double sided so there are no links to it.



This is the programmer board for the 68HC705K1 Motorola microcontroller. It plugs into the parallel port of the host computer.

The screen shot in Fig.1 shows a program listing as it appears in the text editor, but with the complete instruction set of the 'K1 controller superimposed in another window. This feature alone is probably enough for any frustrated programmer to want this software!

The mouse-driven text editor also features an almost Windows-like interface, with movable and sizable windows. There's an extensive help file, a clipboard (which can be viewed), and a host of commands normally only found in a word processor. For instance, the mouse can be used to select blocks of text for copying to the clipboard, and there's commands to search and/or replace text.

The manual for the system is also on the disk, along with numerous sample programs you can use to either experiment with, or as part of your own programs.

So, the development process starts by producing the source code with the text editor, after which it's converted into Motorola's .S19 format using the cross-assembler. The program is then tested in the simulator. Once everything works as it should, the 'K1 microcontroller to be programmed is plugged into the programmer PCB and the programmer driver software is called up to do the rest.

Programmer PCB

The circuit of the programmer PCB is shown in Fig.2. As you can see, there's not much to the circuit, as most of the work is done by the programmer software.

The 12V DC supply to the board is fed to IC2, where it's regulated to give a +5V supply. The 12V input also powers the switching regulator around IC3, which produces a 20V DC output at pin 1. This voltage is regulated by zener diodes Z1 and Z2 to give a programming voltage of 16.8V for the 'K1 being programmed (IC1).

The interface to the parallel port of an IBM compatible computer is via an on-board DB25 plug and a standard DB25 printer cable. The eight data lines (D0 to D7) transfer data to the 'K1 being programmed, and the remaining lines provide control and communication between the programmer and the computer.

In summary

Because this project is similar to the previous 68705 development systems by Robert Priestly, we have only described those parts that are unique to this project. To get a better idea of the versatility of the system, refer to the previous articles. And at around $70, surely this has to be the most cost effective 'K1 microcontroller programming system we've ever described ❖

PARTS LIST

Resistors

All 1/4W:

R1,2	470 ohm
R3	220k
R4	10k
R5	1 ohm
R6,7	180 ohm
R8,9	2.2k

Capacitors

C1-4	0.1uF ceramic
C5,6	10uF 25V RB electrolytic

Semiconductors

LED1	green 5mm LED
D1	1N4001 diode
Z1	10V 1/2W zener diode
Z2	6.8V 1/2W zener diode
IC1,2	78L05 3-terminal 5V regulator
IC3	78S40

Miscellaneous

Silk-screened PCB, 60 x 65mm; 10mH inductor (I1); 16- pin IC socket for 'K1 microcontroller; 16-pin IC socket for IC3; PCB mount DB25 plug; 3.5mm PCB mount phono socket; 12V DC plugpack; softare disk; two PCB mount two-way slide switches.

KIT AVAILABLE

A kit of parts for this project is available from:
Oztechnics
PO Box 38,
Illawong, NSW 2234.
Phone (02) 541 0310
Fax (02) 541 0734
Email oztec@ozemail.com.au

'K1 development system, PCB, on-board components and all software as described	$70
'K1 microcontroller IC, POA HC05 applications guide and 'K1 data books also available.	
Microcontroller kit as reviewed in EA July '94	$280
P&P	$7

NEW PRODUCTS

PCB mount switches

A new series of PCB mount switches has been released by Diptronics. Included is a range of rotary DIP switches, which measure 10 x 10mm. These are available with flat or high actuator and in surface mount or through-hole versions.

Other switches include a range of tactile switches. Available in right angle and ground terminal types, they feature a sharp 'click' feel when pressed. Insert moulding in the contact combined with special treatment prevents flux build-up during soldering and permits auto-dipping.

For further information circle 242 on the reader service coupon or contact Adilam Electronics, 3 Nicole Close, North Bayswater 3153; phone (008) 800 482.

Audio line and speaker switch boxes

Altronics has available a new range of switch boxes for stereo audio or speaker switching. The switchers include a four-way line switcher (audio signals only), a two-way speaker and input selector, and two-way and four-way speaker switch boxes. The four-way input selector allows any one of four stereo audio inputs to be switched to a stereo input of an amplifier, and is priced at $37.50. The

two-way speaker switch and input selector includes two independent stereo speaker switches, and automatically maintains correct impedance at the amplifier speaker output. This unit also selects either of two auxiliary audio inputs via a rocker switch on the front panel. It has an RRP of $49.50.

The two-way speaker switch box has two independent stereo speaker switches and automatically maintains correct impedance at the amplifier speaker output. It includes spring clip terminals for easy speaker wire connections and costs $39.95. The four way speaker switch box is similar, but has four independent stereo speaker switches. It costs $49.95.

For further information circle 241 on the reader service coupon or contact Altronics, 174 Roe Street, Perth, 6000; phone (09) 328 1599.

MATV amplifier

The 905 series television amplifier system, designed and manufactured by Alcad of Spain, is a low cost, single channel amplifier system that allows the level of each channel to be adjusted independently, so uniform output levels are delivered into a multiple outlet antenna system in a large house or block or units.

The introduction of a low power UHF channel 31 service in some major Australian cities has increased the need for this type of system.

A feature of Alcad's 905 series is an inbuilt signal measurement system, making installation easier. The series also has inputs for satellite IF and 88-108MHz FM.

A combined mounting rack and power supply is used to mount up to seven single channel amplifiers on one rack, with two inputs for either five and two or four and three channels. One configura-

Microwave oven has word prompting

The new NNC855B microwave oven from Panasonic has a word prompting feature that instructs the user via a scrolled message on the display screen. In total there are over 50 instructions programmed into the oven, covering every feature of operation including how to program recipes, how to use auto defrost and reheat, how to set the clock, and even prompt action during a cooking cycle. Word prompting allows the oven to be used immediately, without having to refer to the instruction manual.

The new oven has four different cooking modes: microwave; convection; grill and combination. Combination combines the speed of microwave cooking with the crisp, brown cooking results of traditional convectional cooking.

It has a 1300 watt quartz element which preheats instantaneously (no reheating required) and is able to 'flash brown' and grill foods. Another 1400W element at the rear of the oven has a fan for air circulation, for baking. The oven also has 900 watts of microwave power and a capacity of 32 litres. The new see through door allows the user to easily observe the contents of the oven without opening the door.

The oven also incorporates the 'Genius' sensor which allows the user to program the entire cooking cycle for popular foods such as chicken, vegetables, rice and fish. The RRP is $769.

For further information contact Panasonic's Customer Care Centre on 132 600.

NEW PRODUCTS

Hot jet handpiece

Royston Electronics has introduced the Royel HJH100 hot jet handpiece. The unit is suitable for reflow soldering, solder paste reflow, with particular application to surface mount circuitry, testing components and for actuating heat shrink tubing.

The handpiece can be operated from the HJ1000 variable air flow and digital feedback controlled power unit, or any of the Royel Thermatic desoldering/soldering stations. It has an N type thermocouple sensor at the base of the delivery nozzle, which allows a continuous digital readout of the actual air/gas flow temperature.

Designed for use on electronic circuits and specifically for surface mount circuitry, the handpiece is made from static dissipative air/gas feeding tube to avoid electrical damage to components or circuitry.

For further information circle 246 on the reader service coupon or contact Royston Electronics, PO Box 328, Mount Waverley 3149; phone (03) 543 5122.

tion has four modules on one input for channels 2, 7, 9 and 10, with three modules on the second input for channels 28, 31 and 0 for in-house VCR, etc.

For further information circle 243 on the reader service coupon or contact Peter C. Lacey Services, 80 Dandenong Road, Frankston 3199.

Code changing vehicle alarm

The Securicode is claimed to be an ultra-high security vehiclar security system. Its main feature is its innovative (and patented) code changing technology. With the ever increasing use of code learning devices (as used by a majority of professional car thieves), anything using remote control operation with a fixed code is not secure.

Securicode has codes changing continuously and automatically in a synchronised way, between transmitter and receiver.

Not to be confused with 'code hoppers' (which are not immune from being bypassed electronically), Securicode is microcontroller based and all functions are software driven. When coupled with effective immobilising circuits, the units offers a very high level of vehicle protection.

For further information circle 247 on the reader service coupon or contact Securicode, 4/810 Princes Highway, Springvale 3173; phone (03) 548 3300.

Burnishing and cleaning tools

The Eraser Company has announced its new model E100/C and E/100F fibreglass cleaning and burnishing tools. These are refillable cleaning tools used in the same manner as a pen for applications like contact cleaning, removing rust spots, erasing printing on components etc. The tools use interchangeable refills for more aggressive cleaning action, while the E100/F contains a fine grade refill for more sensitive cleaning applications.

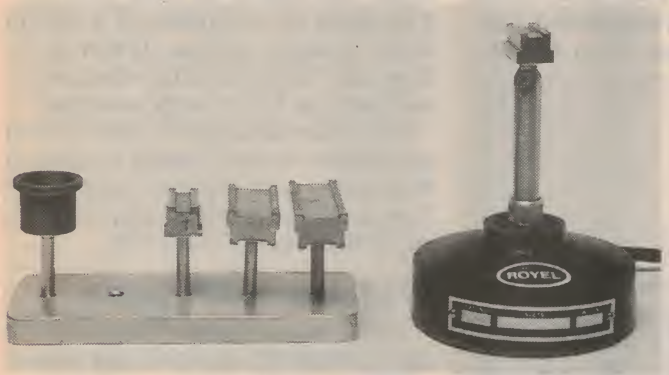
The body of the tool is plastic, with a see through barrel to allow the operator to see when the refill needs replacing.

The length of the exposed brush is adjustable by a knob on the top of the body. The tools are colour coded blue for coarse grade, and red for fine grade. They are 95mm long; the cleaning tip is rectangular and measures 17.9 x 3.1mm.

For further information contact The EraserCompany, PO Box 4961 Olivia Drive, Syracuse, New York 13221; phone (315) 454 3237.

Temperature controlled desoldering solder pot

Royston Electronics has introduced a feedback temperature controlled version of its reliable all lead reflow desoldering unit, which has simplified the task of removing and replacing thru-hole multi-pin packages.



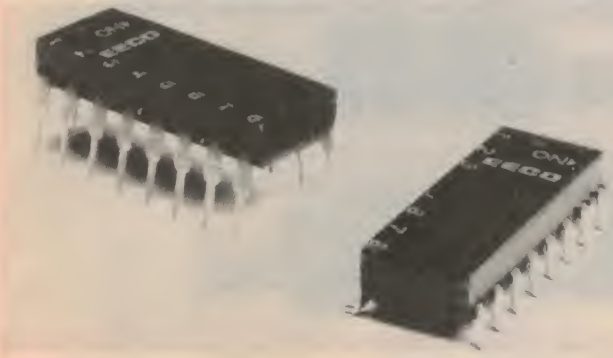
Each of the heads has milled grooves, corresponding to dual-in-line component pitch, along which resin cored solder is melted, prior to immersion of the component to be removed. Reflowing the solder on each pin in a multi-pin package, prior to withdrawal, avoids the possibility of pulling out the metallisation in a plated-thru hole, which may not have been brought to the molten stage after the application of a vacuum desoldering tool.

A one ounce solder pot crucible can be substituted for one of the all lead reflow heads, to facilitate pre-tinning of fine lead components at minimum temperatures to avoid loss of lead material by dissolution in the tin content of the solder. The pre-tinning of gold plated heads, which otherwise will cause solder joint embrittlement, can also be performed.

For further information circle 249 on the reader service coupon or contact Royston Electronics, 27 Normanby Road, Notting Hill 3168; phone (03) 543 5122, fax (03) 544 4894.

High quality DIP switch

The Eeco 4600 'Minidip' series is a second generation dual-in-line design, which is end stackable for ease of PCB layouts. Available in four through 10 positions (including odd numbers) and 12 positions, the 4600 series features a self cleaning, four point bifurcated wiping action which gives greater contact integrity, reliability and most importantly, greater increased switching and non-switching current handling capacity per pole than is normal for ordinary DIP switches. This feature, combined with low contact resistance, makes it well suited to data communications and telecommunications applications, as well as other demanding designs.



Options include a sealed or unsealed package and three lead configurations; gullwing or 'J' leads for surface mounting, or standard machine insertable leads. Naturally, the 4600 series is suitable for standard automated desoldering and cleaning techniques.

For further information circle 250 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4455.

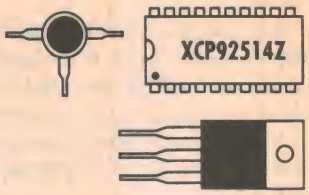
Efficient 60 watt DC/DC converter

Power Convertibles has introduced a new family of DC/DC converters, claimed to offer the highest efficiency in its class. The VKP60R provides 60 watts in a 58 x 61 x 11mm package and operates over a 36 - 72V DC input supply range, making it ideal for telecommunications and battery operated applications. Available DC outputs are 3.3V, 5V, 12V, 15V, 24V and 28V. Typical efficiences are 84% at 3.3V, 88% at 5V and 91% at 15V.

The series operates at full power up to a baseplate temperature of 100°C and is isolated from input to output with a 1500V DC barrier. Both load and line regulation are specified as +/- 0.05% maximum over all load and line conditions, and all units are protected against output overvoltage and overcurrent conditions as well as baseplate overtemperature.

For further information circle 248 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (008) 335 245. ❖

Solid State Update



KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

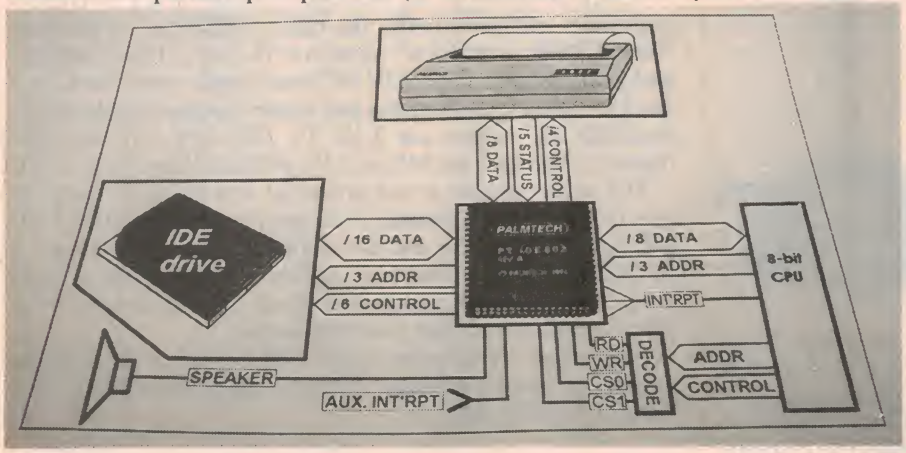
IDE interface for 8-bit CPUs

Palmtech's PT IDE802/803 devices are single chip IDE (hard disk drive) interfaces for 8-bit CPUs. They incorporate an additional 8-bit uni/bidirectional parallel port plus ten (11 for the '803) handshake or extra I/O lines, suitable for implementing a printer port. They also include a controller for three interrupts (two for the '803).

The eight to 16-bit data conversion is fully transparent, with an IDE sector accessed as 512 8-bit bytes rather than 256 16-bit words. The devices accept any IDE drive conforming to the CAM ATA standard, and do not need external buffering to the drive or printer.

They can be coupled to most 8-bit CPUs with little or no extra glue logic. The chips are available in a 68-pin PLCC package and use 100mA at 5V. They add 75ns to the IDE drive access time and cost $55 in single quantities.

For further information circle 277 on the reader service coupon or contact Palmtech, cnr Moonah and Wills Streets, Boulia, 4829; phone (077) 463 109, or fax (077) 463 198.



EPLD has 12,000 gates

Altera has released the 560 macrocell EPM9560, the first and largest member of Altera's new MAX9000 family of EPLD devices. With 560 macrocells and up to 216 I/O pins, this 12,000 gate device is claimed to provide more than twice the density of the

Solid state switches for analog line cards

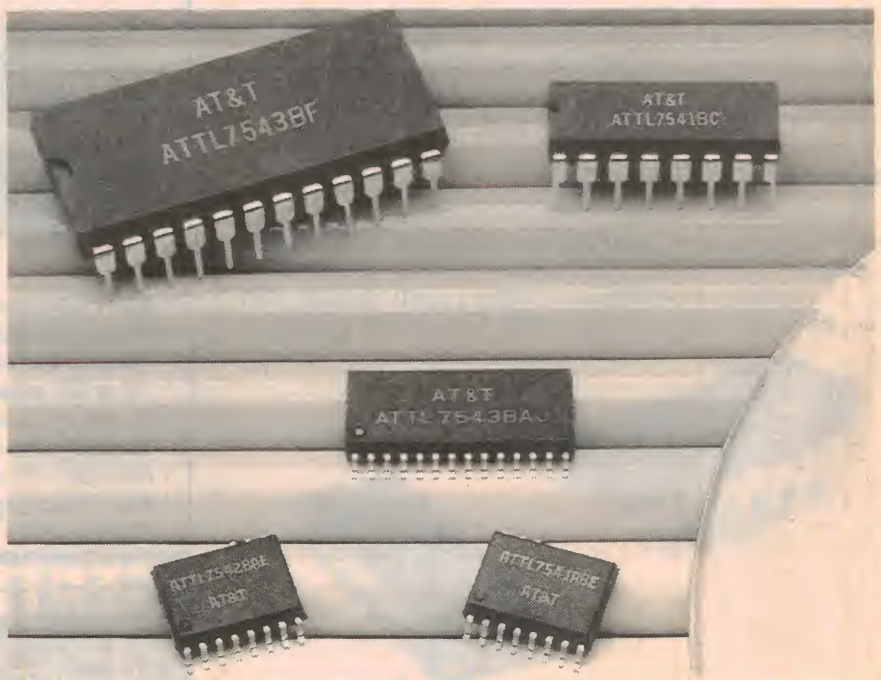
The new ATTL754X family of solid state switching devices generate no impulse noise during a ringing cadence, and thereby eliminate the need for the zero current switching typically needed with older generation relays. The combination of very low and matched on-resistance is claimed to simplify circuit board design. The ICs consume around 15mW and feature built-in current limiting, thermal shutdown and subscriber line interface circuit (SLIC) protection.

The ATTL7541 solid state ringing relay is a '2 Form C' relay designed to provide power ringing access to tip and ring in any analog line card application such as central office equipment, digital added main line, digital loop carrier, hybrid fibre coax and fibre in the loop line cards. It is packaged in a 16-pin DIP or SOG.

The ATTL7542 tip/ring access switch contains the functionality of two 2 Form C relays that provide power ring and line access functions, all controllable by two logic input levels. It is packaged in a 16-pin SOG.

The ATTL7543 line card access switch contains the functionality of three 2 Form C relays in a single package. It is typically used to support power ringing, line access SLIC test access and ringing generator test access, all controlled by three logic inputs. It is packaged in a 24-pin DIP.

For further information circle 271 on the reader service coupon or contact Zatek, PO Box 397, West Ryde 2114; phone (02) 874 0122.



largest EPLD available today. Features include in-system programming (ISP), mixed voltage I/O operation, JTAG and PCI compliance.

ISP makes design prototyping and production easier by eliminating device handling. Since the devices can be programmed on the production board, ISP removes the programming step, simplifying the manufacturing flows. ISP also enables a mechanism for field design upgrades.

Designs can be revised in the field by downloading new device configurations from data links such as modems and system networks.

For further information circle 276 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

PCI development kit for PLDs

Veltek has announced the availability of a PCI (peripheral component interface) development kit for use with members of Altera's FLEXlogic, MAX 7000, FLEX 8000 and MAX 9000 families of programmable logic devices (PLDs).

The kit includes technical information for designing with this latest industry standard bus architecture, along with a PCI development macrofunction dis-kette that contains PC peripheral interface solutions.

The development kit provides customisable PCI interfaces for peripheral designs such as graphics controllers and multimedia applications. Additionally, data communications applications such as ATM networking systems are using PCI to increase throughput.

For further information circle 274 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Gas sensor

The Figaro gas sensor is a solid state device mainly composed of sintered tin dioxide, which detects gases through an increase in electrical conductivity when the reducing gases are absorbed on the sensor's surface. The device is claimed to have excellent stability and performance, and important features in gas detection.

Features include long life and good reliability, high sensitivity, quick response, high resistance to poisoning, excellent durability, large output signal and low cost.

For further information circle 272 on the reader service coupon or contact Adilam Electronics, 3 Nichole Close, North Bayswater 3153; phone (008) 800 482.

750MHz op-amp

The CLC440 is the latest addition to Comlinears CLC44X series of high speed monolithic op-amps. The op-amp combines the speed of current feedback (1500V/us slew rate and 750MHz unit gain bandwidth) with the versatility of voltage feedback.

Features include very low differential gain differential phase of 0.015% and 0.025°. Also, the chip provides wide dynamic range applications with very low harmonic distortion: (above 70dBc at 5MHz with a 2Vp/p output signal).

The device can also deliver up to 90mA of output current, and operates on a single 5V power supply. It is available in 8-pin plastic DIPs or SOICs.

For further information circle 275 on the reader service coupon or contact Zatek, PO Box 397, West Ryde 2114; phone (02) 874 0122.

Quad op-amp has 450MHz bandwidth

Burr-Brown's new OPA4658 is a quad ultra-wideband, low power current feedback operational amplifier featuring a high slew rate and low differential gain/phase errors. Its low 50mW power dissipation combines with a high bandwidth of 450MHz in a gain of two to make the OPA4658 a perfect low cost choice for medical imaging, high resolution video, communications, pulse amplifiers, and high speed signal processing applications.

For further information circle 276 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone Toll Free (008) 335 245.

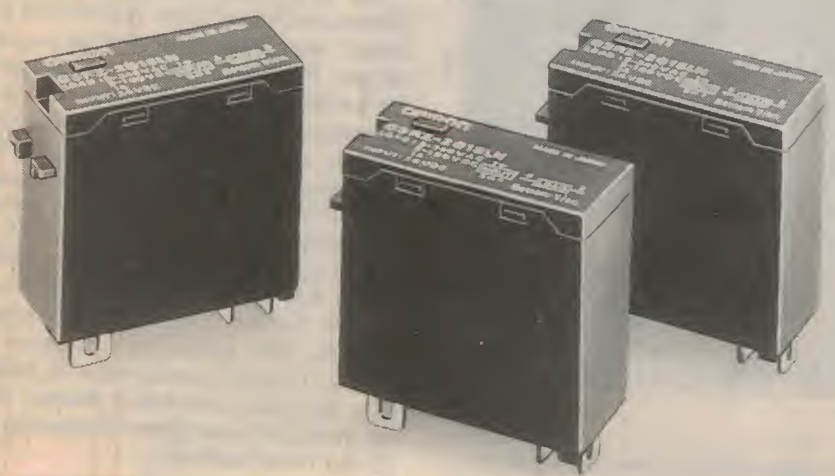
SSR is form factor compatible

Omron Electronics has released the G3R series of solid state relay, packaged in the same form factor and footprint as the G2R electromechanical relay.

AC versions (with or without zero-crossing function), and DC versions are available in PCB or plug-in terminations capable of switching up to 2A with 2,500V AC isolation. The SSRs can be ordered with LED indicators.

Sockets for chassis, DIN-rail and PCB mounting are available.

For further information circle 273 on the reader service coupon or contact DGE Systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (049) 61 3311.



Test & Measuring Instruments Feature:

FLUKE'S ENHANCED 'SERIES II' SCOPEMETERS

Philips/Fluke has recently expanded its range of compact hand-held digital ScopeMeters with four new Series II models, offering enhanced features in comparison with the original models. Here we take a look at the new 'top of the range' model 99, which offers all of the enhanced features — including a full built-in 'online help' facility.

by JIM ROWE

When Philips/Fluke released the ScopeMeter range of handheld multifunction instruments in 1991, they created a lot of interest. Combining a 3000-count true-RMS DMM with a 50MHz bandwidth DSO and frequency counter in a compact and rugged form, the new instruments represented an important step forward in terms of the tools available for field servicing and maintenance.

The original ScopeMeter models won a number of industry awards, and have been very successful. Their success in fact encouraged other T&M makers to develop similar multifunction portable instruments, such as the Tektronix THM565 TekMeter reviewed in our May 1994 issue.

But recently the ScopeMeter range itself has been expanded and enhanced, with the addition of four new 'Series II' models: the models 91 and 92, the model 96 and the model 99. The new models offer additional features and facilities, which should make them of even more value for measurements 'in the field'.

Among the measurement functions provided by the new instruments is a 'Measure Menu' facility, which allows the user to select easily any of 30 different measurement tasks. Upon selection of any desired task, the instrument automatically configures itself to make the measurement.

Another feature is a selectable 'Continuous Autoset' function, which as the name suggests allows the instrument to continuously 'track' the signal being measured, and dynamically adjusts the instrument's range and mode settings to optimise measurements or signal display.

Further features of the new models include a windowing on-screen menu system for manual mode, range and function selection, to make the instruments much easier and more convenient to 'drive'. Like many modern bench DSO's the new ScopeMeters also allow continuous measurement and indication of many signal parameters while in scope mode, reducing the need to switch back to DMM/counter modes.

In any case the signal waveform is also displayed in meter mode, so that the two modes overlap in function a lot more than before.

There's also a pair of 'Min/Max' functions on the new models, one of which allows you to see the maximum and minimum values of a varying signal. The other allows you to graph the maximum, minimum and average values of a signal over a period of time — which can be anywhere between two minutes and 30 days. Very handy for spotting problems due to cyclic events!

One of the nicest features in the new models, though, is an inbuilt 'on line help' facility, which provides context-sensitive help information at any time — in much the same way as most PC software running under Windows. In this case all you have to do, if you're unsure of the correct procedure at any stage, is press the ScopeMeter's 'i' button, and the appropriate help information appears on the screen. This is an excellent system in a portable instrument, as you generally won't have the user manual accessible to you out in the field...

The new model 96 and 99 ScopeMeters also feature large, non-volatile internal memories, for storing screen images, instrument setups and measurement waveforms/data. The waveform and parameters of a reference or 'bogie' signal can also be stored in memory, for comparison with a signal in the equipment being tested. The stored waveforms/data can be recalled at any time, or sent to a printer. In the case of the model 99 the data can also be downloaded to a PC, for further analysis or permanent storage. The model 96 can store 20 setups, 10 signal waveforms with setting data, and up to five screen images; with the model 99 these figures increase to 40, 20 and 10 respectively.

Like the existing Scopemeters, the

Series II models use an 84mm square 'super twisted' LCD display, with a resolution of 240 x 240 pixels and user-selected electroluminescent backlighting. They operate from an internal 4.8V NiCad battery pack, which typically runs the instrument for about four hours after charging from the mains via the supplied charger. Charging takes about 16 hours for a fully flattened battery.

Rated frequency response of the ScopeMeters in scope mode is from DC to 50MHz (-3dB), with a maximum sampling rate of 25MS/s and a resolution of eight bits. Input impedance is a standard 1M/25pF, or 10M/13pF with the 10:1 divider probes. All models except the 91 have dual input channels.

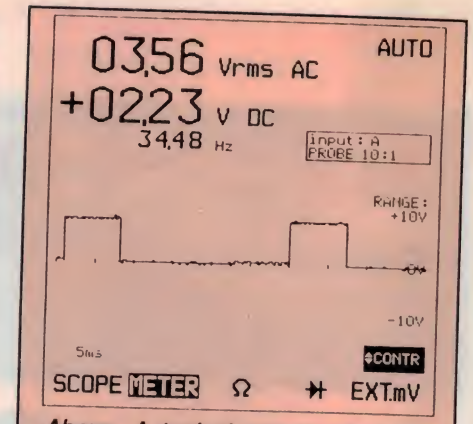
The horizontal sweep range is from 10ns/div to 1s/div, with a choice of three modes: recurrent, single shot and roll. Record length is either 256 or 512 samples (10 or 20 divisions). There's a comprehensive range of trigger facilities, and in the case of the models 96 and 99 a wide range of cursor-driven waveform parameter measurements. The model 99 also provides 'waveform maths' functions including add, subtract, multiply, invert, filtering or integration of the input signals. With the use of optional current probes, it can calculate instantaneous or mean (real) power.

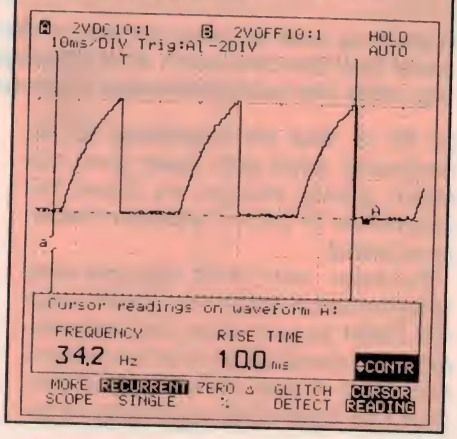
A very useful feature of the instruments in scope mode is the ability to detect and indicate glitches of less than 40ns duration, at sweep speeds of 1us/div or slower in input A.

Another nice feature is the 'analog like' grey-scale display, which gives a good simulation of the way fast and short-lived phenomena are displayed less brightly on a conventional analog scope.

In meter mode, the instruments provide eight basic DC voltage ranges from 100mV to 300V FS, with measurements to 3kV possible using a 10:1 probe. Basic accuracy is +/-(0.5% + 5 counts). A similar set of ranges is available for AC or (AC + DC) true-RMS measurement, except that here the top range only extends to 250V FS. Rated accuracy is +/-(1% + 10 counts) at 50/60Hz, or +/-(2% + 15 counts) between 20Hz and 20kHz. This further discounts to +/- (3% + 20 counts) between 5Hz and 1MHz.

There are seven resistance ranges, with FS readings ranging from 30Ω to 30MΩ. Rated accuracy on all but the lowest range is +/-(0.5% + 5 counts), and +/-(2.5% + 25 counts) on the 30Ω range.

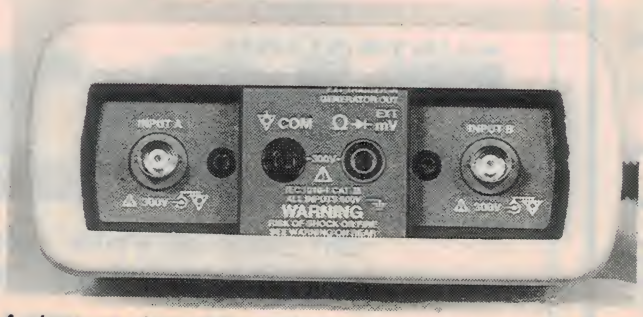




Above: A typical screen when the ScopeMeter is used in 'meter' mode. Below: A screen in 'scope' mode.

Frequency measurements are possible between 1Hz and 5MHz, with four digits of resolution and a rated accuracy of +/-(0.5% + 2 counts). Also provided is the ability to measure RPM, duty cycle, pulse width, dBV, dBm, dBW or audio/RF watts, apart from the usual diode test range.

In addition to the features already mentioned, the new model 99 ScopeMeter also includes an inbuilt spot-frequency LF signal generator, capable of providing either a 1V p-p sinewave at 976Hz, or a 5V p-p squarewave of either 488, 976 or 1950Hz. In each case the output impedance is 400Ω, and the sinewave output has a rated distortion of less than 3% (THD).



A close up view of the main input connectors, at the top of the ScopeMeter. The meter jacks are in the centre with the scope inputs on either side.

Like the model 96, the model 99 has provision for an optically isolated RS-232C interface cable, via a small connector moulded into the right hand side of the case. However with the 99 this interface can be used not just for dumping screens and measurements to a serial printer (Epson FX/LQ, HP ThinkJet or Laserjet), but also for linking the ScopeMeter to a PC. This allows the 99 to upload and download measurement set-ups, or download waveforms and measurements for further analysis, storage or data logging.

Trying one out

We were very kindly loaned a ScopeMeter 99 to try out on your behalf, by Sydney's Fluke/Philips T&M distributor Obiat. As expected it gave a very good account of itself, and we found it a pleasure to use.

Although not exactly pocket sized — it measures 260 x 130 x 60mm, and weighs 1.5kg — there's no denying that it still delivers a great deal of measurement horsepower in a convenient and *relatively* compact package.

In terms of operation, we particularly liked the 'Auto Set' button, which like that on many modern DSO's gives you a stable and optimised (or very nearly so) display of just about any signal, with a single key press. We also liked the built-in online help system, and its ability to provide context sensitive help information at virtually any time — and again with a single key press.

Apart from these special points, we also liked the way the new ScopeMeter is operated via a friendly system of menus, and the way it provides greater functional overlap between the scope and meter modes, to reduce the need for mode switching. In general it seems notably more convenient to use than the earlier models.

The performance was checked out, and generally either met or comfortably exceeded the quoted specs. For example the upper frequency response of both vertical scope channels measured -3dB at around 68MHz, well above the quoted 50MHz, with a fairly smooth rolloff and very little evidence of aliasing.

Obiat sent one of the optional optically isolated serial interfaces and its matching software, so we could try out this facility as well. However either we were doing something wrong, or the sample interface and/or its software were faulty, because we couldn't get

FLUKE'S 'SERIES II' SCOPEMETERS

A close up view showing the side of the ScopeMeter, and the optically isolated serial interface connector. Also shown is the matching cable connector, on the top, while the round hole below is the socket for the power input lead.

the PC to 'find' the ScopeMeter via the designated serial port. Apart from this minor glitch, though, we found the ScopeMeter 99 a most impressive instrument indeed.

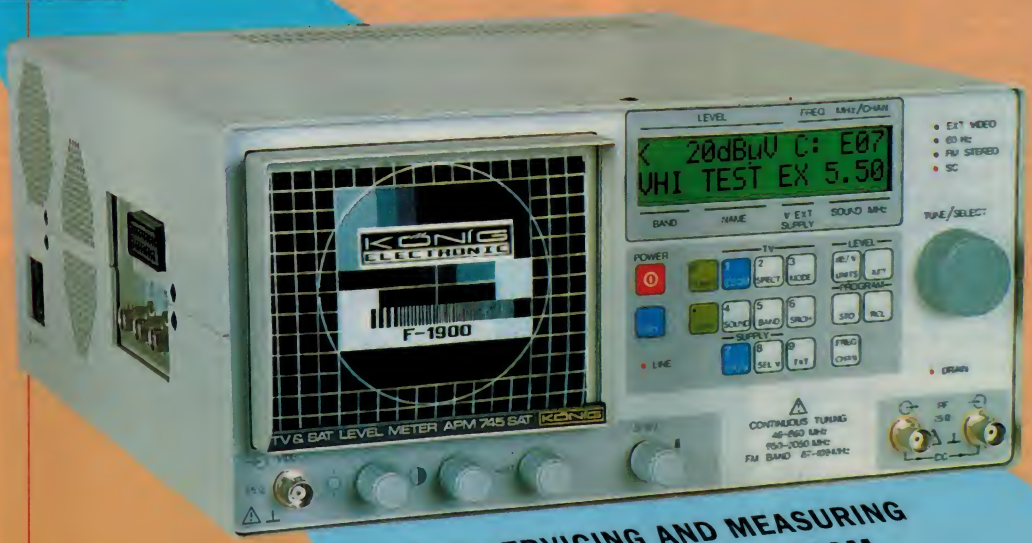
For those who would otherwise need to lug around a dual-trace 50MHz scope and DMM for performing field measurements, it should be an attractive proposition. And coming from Philips/Fluke, there's an impressively wide range of optional probes, adaptors and other well made accessories.

The quoted price of the Series II Model 99 is $3650, with the model 96, 92 and 91 priced at $3190, $2650 and $1980 respectively. Further information on both these and the original ScopeMeter models is available from Obiat, of 129 Queen Street (PO Box 37), Beaconsfield 2015; phone (02) 698 4776, or fax (02) 699 9170. ❖

NEW FIELD STRENGTH METER APM 745 SAT

- Reception range 47 - 2050 MHz includes Satellite and MMDS
- Level measuring range 20 - 130 dBµV
- Microprocessor-controlled keyboard
- 99 program storages with station identification
- Teletext, printer (optional), RS-232 C-interface
- With spectrum analyzer, zoom, Line blanking interval & analog level indication and reference tone
- Professional multinorm field strength meter for worldwide application

KÖNIG ELECTRONIC



KONIG SERVICING AND MEASURING INSTRUMENTS AVAILABLE FROM SKANDIA ELECTRONICS

CATALOGUES AVAILABLE ON REQUEST

- Colour generators
- Field strength meters
- Digital meters
- Audio meters
- Various testers & tools
- Picture tube rejuvenators
- Variable isolation transformer and power supplies
- Oscilloscopes

Also Available

KONIG APM 380 SAT

Australia's most versatile field strength meter for MMDS, Terrestrial and Satellite. The most popular meter used by Galaxy TV installers.

READER INFO NO. 28

Skandia

SKANDIA ELECTRONICS PTY. LTD.
HEAD OFFICE: 183 BURWOOD ROAD,
(PO BOX 488) HAWTHORN, VIC. 3122
TEL: (03) 9819 2466 FAX: (03) 9819 4281
SYDNEY OFFICE: SUITE 12, 354-356
CHURCH STREET, PARRAMATTA, NSW 2150
TEL: (02) 630 0888 FAX: (02) 630 8690

SOLE AUSTRALASIAN DISTRIBUTORS FOR KONIG ELECTRONIC OF GERMANY.

Test & Measuring Instruments Feature:

HP's new 54620A Logic Analyser

Latest addition to the Hewlett-Packard 54600 series of lower-priced test instruments is the 54620A Logic Analyser, designed to be as easy to drive as a scope. It also offers 16 input channels, a maximum sampling speed of 500MS/s, sweep speeds up to 5ns/div and glitch capture of pulses as narrow as 3.5ns — plus the ability to be interfaced easily with a PC.

by JIM ROWE

When Hewlett-Packard released its 54600-Series of lower priced DSOs in early 1991, they caused quite an upheaval in the T&M market. Not only were the new instruments notably cheaper than existing instruments of comparable performance, but they were more compact, lighter in weight and also significantly easier to use. Perhaps even more impressive was the way they combined the fast display updating speed and 'feel' of an analog scope with the added functions of a modern DSO, in a seamless and transparent way.

After trying out the new 54620A for a few weeks, I suspect that HP has just pulled off a similar and just as significant coup in the realm of logic analysers.

The 54620A is built in virtually the same case as the 54600 series of scopes, and is clearly a 'close relative'. Not surprisingly it seems to be made in the same Colorado Springs division responsible for the scopes, and even takes many of the same optional add-ons — like the 54650A HP-IB Interface Module, the 54652A Parallel Interface Module and the 54651A RS-232C Interface Module (used to link it with a PC). It also mates with HP's *Benchlink for Windows* software, developed for easy communication between a PC and the 54600 series scopes.

Just as HP's engineers and marketing people did a lot of customer research before designing the scopes, to find out what users *really* wanted, they seem to have done a similar exercise with the 54620A. Which makes a great deal of sense, of course, because this type of research obviously paid off the first time.

I guess it doesn't come as any surprise to learn that they found much the same situation with logic analysers as they'd found previously with DSO's — namely, that many engineers and technicians find the traditional instruments just too complicated to drive, and often rather 'user unfriendly' into the bargain.

When they asked what users would *like* in a logic analyser, they generally got a fairly straightforward answer: 'Just make it as easy to drive as a scope!' So that's exactly what they set out to do, in developing the 54620A.

To my mind they've succeeded admirably. Like the 54600 series of scopes the new analyser is surprisingly straightforward to use, with relatively few controls and much of the same 'intuitive' feel that is evident with its scope siblings. In fact many of the controls are virtually the same, like the horizontal timebase and delay controls, and the mode and general setup controls.

As with the scopes, many of the analyser functions are set up using a series of on-screen menues, in conjunction with either the front-panel controls or six 'software configured' buttons along the bottom of the display screen itself. And even more like the scopes, it also has one of those great 'Autoscale' buttons, to perform a complete automatic setup with a single keypress.

Obviously Autoscale can't read your mind and set up the triggering to capture the exact logic event you're interested in, but a lot of the time it will at least get you quickly into the basic signal 'ballpark' where the event is likely to be. Which is a big step forward, compared with many traditional logic analysers.

(Incidentally, Autoscale also scans the inputs to detect which ones seem 'active', and automatically limits the display to these alone for optimum clarity. Of course you can very easily override it and reinstate the other inputs, if you wish.)

Another nice feature is that the 54620A allows you to apply a six-character 'label' to each channel, to improve the ease of reading the screen display and any printed screen dumps. The labels are added via an easy-to-drive front panel facility, which has a 'library' of handy labels built in, to speed things up. You only have assemble the really unusual ones yourself, one character at a time...

Analyser performance

In terms of its logic analysis capabilities, the 54620A is a 16-channel instrument. The main input channels are grouped in two sets of eight, numbered 0 - 15, and are brought out to a 40-way DIL connector at the lower right corner of the front panel. A matching cable assembly plugs into this connector, and brings each group of eight inputs out via a special *woven* ribbon cable to a 'probe head' fitted with eight flying signal leads — each ending in a numbered pinjack — and a matching earth pinjack. Also supplied is a set of micro spring clips, which mate with the pinjacks to allow connections to device pins.

All of these main inputs are of quite high impedance (100k/8pF), and can be programmed for preset threshold levels corresponding to TTL, CMOS or ECL logic levels. Rated channel to channel timing skew is typically 2ns, and 3.0ns maximum.

As well as the 16 basic input channels, there's also an 'External Trigger' input via a front panel BNC connector. This input has an input impedance of 1M/12pF, has an independently adjustable threshold level and is suitable for use with standard probes such as the HP 1007X.

The maximum sample rate of the 54620A is 500MS/s, giving it a minimum timing resolution of 2ns. The range of sweep speeds is from 1s/div up to 5ns/div, with both a main and delayed timebase system. It takes 2K samples per record at sampling periods of 8ns and slower (i.e., sweep speeds of 1us/div to 1s/div), and 8K samples per record at the two fastest sampling periods of 2ns and 4ns (sweep speeds of 5ns/div to 500ns/div).

Basic timebase accuracy is 0.01%, and the cursor measurement accuracy for a single-channel timing measurement is +/-(Sample period + 0.01% of reading) +/-0.2% of screen width. This is degraded by the channel to channel skew, for channel to channel timing measurements, and by a delay jitter of 10ppm in delayed timebase mode.

As this is a logic analyser rather than a scope, the delaying system allows both negative (pre-trigger) or positive (post-trigger) sweep delay. The maximum delay is independent of the time reference, which can be in the centre, left or right of the display.

For the two shortest sampling periods the maximum pre-trigger delay is 8077 times the sample period, and 2019 times for the longer sampling periods. For post-trigger delaying the maximum delay for sampling periods of 2ns to 8ns is 8.839ms, and for the longer sampling periods 1,048,575 times the sampling period or 100s, whichever is larger.

In general the delayed sweep can be from twice to 200 million times the main sweep setting, up to a minimum period of 5ns/div, but it must always be at least twice the main sweep speed. The minimum display update rate is 10 full screens per second, regardless of the number of channels being displayed — but assuming no parameter measurements are being taken.

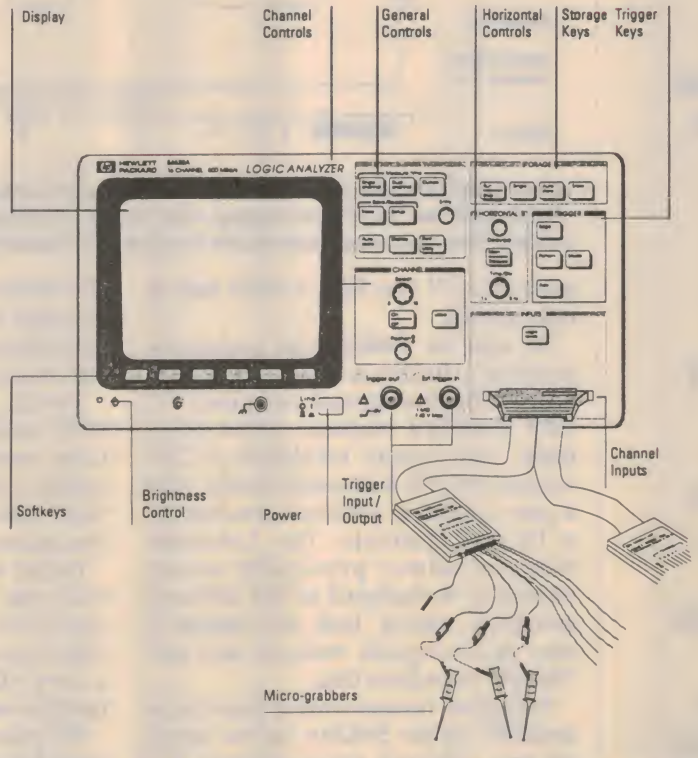
The 'glitch detect and capture' mode is activated automatically at all sweep speeds where the sampling period is greater than 4ns (1us/div and slower), and captures pulses as narrow as 3.5ns. The maximum glitch width is 1ns less than the current sample period.

Needless to say once a set of samples has been captured, you can pan along the waveforms in memory, and 'zoom in' to examine any particular event of interest.

As you might expect from a logic analyser, the triggering system is particularly flexible. In general it can be set to trigger from a very wide range of events, based on the 16 main inputs and the Ext Trigger input. The event can be a logic transition 'edge' on any one of these inputs; a pattern of highs, lows or 'don't cares' on any desired combination of inputs; an AND combination of an edge on one channel, and a pattern; or *two* such 'edge AND pattern' events, combined with a choice of operators including AND, OR, Then, Entered, Exited, Duration longer than, Duration shorter than, and Occurs N times.

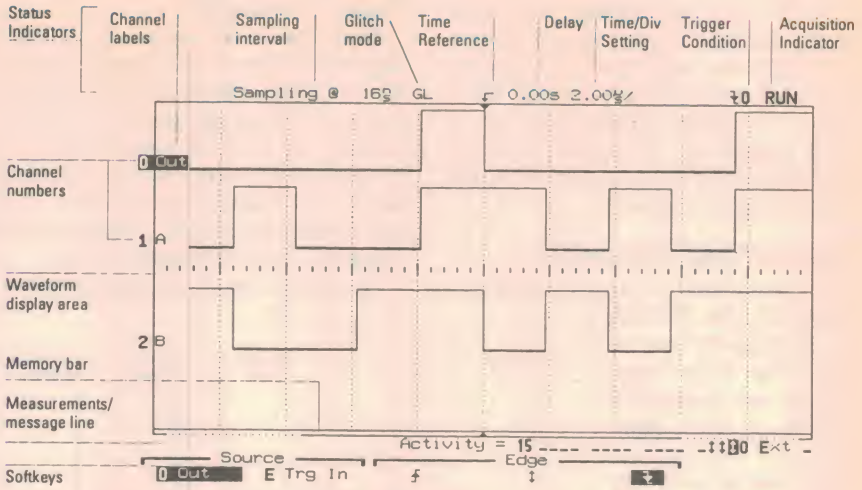
The rated minimum setup time for a pattern, prior to an edge being combined with it for AND triggering, is 3ns plus the channel-to-channel skew. Similarly the minimum pattern hold time, for the same type of triggering, is 5ns plus the skew. The minimum detectable pattern width is 13ns plus the skew at sweep speeds of 5ns/div to 1us/div; at speeds of 2us/div and slower it becomes (1ns + 1 sample period + skew + 0.01%).

By the way, the 54620A also provides a Trigger Out signal, which delivers a rising edge at the detected trigger point — for triggering a scope or other instrument. The Trigger Out signal edge is delayed by approximately 85ns from the trigger event, with a jitter of +/-(sample period + 10ppm). The output is via a second front panel BNC connector, and can deliver a peak to peak output of



Extracted from the Hewlett-Packard manual, this diagram indicates most of the front panel controls and connections of the 54620A logic analyser — plus the input cable assembly.

HP'S 54620A LOGIC ANALYSER



Also taken from the Hewlett-Packard manual, this diagram gives a representation of the analyser's screen display, with many of its features identified. Each of the active channel traces can easily be given an identification label.

more than 2V into 50Ω, or 4.8V into an open circuit.

As with the 54600 series scopes, the analyser's display is via a raster image on a 166mm-diagonal (nominal 7") CRT with fast response green phosphor. The display resolution is 256 vertical by 500 horizontal pixels, with a user-selectable software generated 8 x 10 grid graticule. The Autostore function allows previously stored sweeps to be displayed at half intensity, giving an 'analog' look and making it easy to distinguish between new and 'historic' waveform data.

Standard measurement functions available on the 54620A for the signal on any selected input channel are similar to the timing measurements available on the scopes: Frequency, Period, +Width, -Width and Duty Cycle. For two-channel relative measurements there's Channel-to-Channel Delay, Hold Time and Setup Time. Many other measurements are possible by using the 54620A's two measurement cursors, and the measurement system automatically tracks changes in the horizontal sweep rate and delay controls.

Trying it out

Hewlett-Packard Australia very kindly made a sample 54600A Logic Analyser available for a while, allowing us to get a good 'feel' for both its performance and ease of use. We were certainly most impressed with the instrument, in both respects.

Along with the basic analyser and its input cables, etc., they also provided an HP 54654A 'Self-Paced Training Kit', designed to help users get familiar with the controls and use of both the 54620A and its sibling scopes.

The kit consists of a battery-powered PCB module, which generates quite a large number of carefully-chosen test signals, plus a Training Guide manual which takes you through the familiarisation process.

Before we used the 54620A for anything else, then, we worked through the section of the Training Guide dealing with it, and can report that this provides a very effective way to get yourself familiar with the instrument.

We also used the 54620A to explore around inside a typical PC, to get a further idea of its ease of use. Here again we were pleasantly surprised, and found it notably more 'friendly' than previous logic analysers we've tried.

On the whole, then, I believe that with the 54620A Hewlett-Packard has indeed achieved a very welcome breakthrough in logic analyser design. While retaining plenty of performance and functionality, they've come up with an instrument that is much easier and more intuitive to use than traditional instruments have been. And an instrument that's easier to drive is always going to be more useful in practice than one that isn't, surely.

The quoted price for the 54620A Logic Analyser is $4565 plus tax, with a further $306 plus tax for the optional 54654A Self-Paced Training Kit.

Further information on these products is available by calling the HP Customer Service Centre on 13 1347. ❖

Special Feature:

The latest test and measuring instruments

Graphical multimeter with 0.025% accuracy

Fluke has introduced its new 860 series of graphical multimeters (GMM), a new category of test instrument that combine multimeter functions with a waveform display and other functions.

There are three instruments in the 860 series. Key features of all three include meter mode, waveform display, data logging with graphical readout, in-circuit component testing and logic test mode.

The meter mode has up to 0.025% accuracy, 4.5-digit resolution, a dual digital display that gives information about the parameter being measured and an analog bargraph. Measurement functions include current, resistance, conductance, capacitance, frequency, duty cycle, pulse width, period, dB and voltage.

The waveform display has a bandwidth of 1MHz, and enhances the numeric display by providing more information about the parameter being measured. In graphing mode, the instrument plots readings for up to 30 hours, at intervals from one second to 15 minutes.

The in-circuit test allows signatures of in-circuit components to be obtained for troubleshooting purposes. These signatures are then compared to those of a known good circuit. The logic test indicates logic transitions to 10MHz, shows logic levels, the frequency of activity and the average DC voltage. The model 863 is priced at $795, model 865 is $995 and the 867 is $1295.

For further information, circle 202 on the reader service coupon or contact Philips Scientific and Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

Multimeter and clamp meter range from Europe

The European based Carlo Gavazzi group has released a range of digital multimeters and clamp meters, under the Pantec brand. The multimeters feature arched bargraphs with up to 65 segments and up to 4000 counts.

Other features include true RMS voltage and current ranges, capacitance functions, min/max recording, data hold and data delay modes, auto/manual ranging, ovrload protection, memory store and recall functions, diode test and auto power off. Each meter comes with test leads, holster, battery and operator manual.

The clamp meters feature safety design to IEC 348, true RMS voltage and current ranges, DC current to

Portable DSO plus true RMS DMM

The PalmScope 320 from Escort Instruments combines four full function test instruments.

These are a two channel 20MHz digital storage scope, a 3-3/4 digit true RMS digital mulimeter (with AC/DC current, a seven digit 20MHz frequency period counter, and an eight channel, 20MHz logic analyser.

Specifications include: 2k (1920 point) deep DSO memory; full AC V, DC V, AC A, DC A and ohms functions; a 7-digit frequency counter with a 10ppm basic accuracy; and an eight channel logic analyser with both timing and state signal displays.

The instrument is supplied with oscilloscope and multimeter probes, protective rubber holster, AC power pack, NiCad rechargeable battery pack and slim briefcase style carrying case. Options include RS-232 interface cable, PC data transfer software and logic analyser probes.

For further information circle 201 on the reader service coupon or contact Emona Instruments, 86 Parramatta Road, Camperdown 2050; phone (02) 519 3933.

TEST AND MEASURING INSTRUMENTS

1000A, DC voltage ranges, resistance ranges, continuity test, frequency to 4MHz, data hold, auto and manual ranging and max/min recording.

For further information circle 203 on the reader service coupon or contact Obiat, 129 Queen Street, Beaconsfield 2015; phone (02) 698 4111.

Intelligent Megger

The new intelligent AVO Megger IPAT14 (for 240V rated appliances) and IPAT15 (for 110V and 240V rated appliances) perform a range of electrical and electronic appliance tests including earth continuity, bond, insulation, operation, earth leakage, flash (IPAT15 only), lead and extension lead tests.

They are suitable for periodic safety tests of appliances used by factories, equipment renting companies, hospitals, manufacturers and so on.

The testers can be supplied with an optional barcode reader and barcode label printer for positive identification of tested appliances. Testing programs are menu selected, and the operator can also use the detachable QWERTY keyboard to enter visual inspection details of appliances. Complete test records are stored in the IPAT14/15 memory with 6000 test result capacity. This data can be output to the integral 3-1/2" floppy disk drive, or via the RS-232 port to external printers or host computer.

The IPAT software supplied with the instruments has features that allow user defined pass/fail limits and an asset management feature to indicate 'due for test' reports.

Test results can be viewed on the large, back lit LCD screen and printed via the RS-232 port. Test sequences and results are indicated on the display along with user prompting messages.

For further information circle 204 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 419 9999.

Oscillograph records at 250mm/sec

The latest oscillograph recorder from test and measurement specialist Yokogawa offers high definition, real time recording up to 250mm/sec with large, 256K sample/channel data memories and a 3.5" floppy disk drive, all packed into a compact body with an A4 footprint.

Yokogawa's OR1400 is a fast eight channel universal oscillographic recorder designed to be easy to use through its natueal language displays, plug-in input modules for flexible signal handling, arithmetic and statistical computing capabilities, and versatile mixed analog/digital recording features.

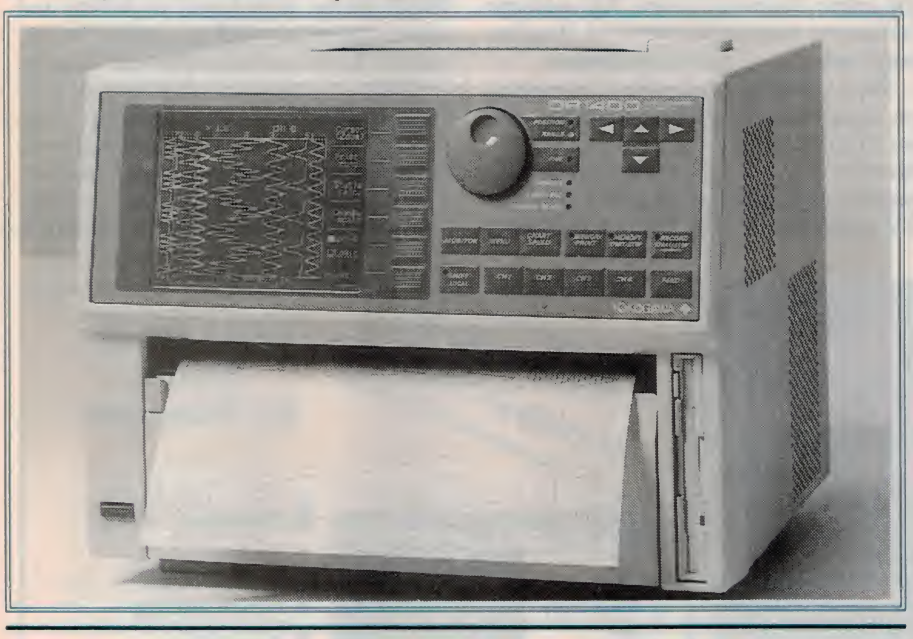
The OR1400 input architecture allows high voltage and universal (voltage/thermocouple) plug-ins to be mixed freely all across all eight channels, to handle signals from thermocouple levels up to 240V AC. The high voltage modules features wide range zero suppression capability.

Range and zero position set up have been designed to have an analog feel, in that they can be set with a rotary knob while viewing an image of the recording trace on the graphic display..

The OR1400's ability to provide clean, clear recordings even at chart speeds up to 250mm/sec is achieved to Yokogawa's innovative dot overlap technology. This eliminates the stepped appearance normally associated with digital based thermal recording.

The built-in 3.5" floppy disk drive permits acquired data to be saved for further analysis on a PC using Yokogawa's accessory software packages.

For further information circle 204 on the reader service card or contact Yokogawa Australia, 25 - 27 Paul Street North, North Ryde 2113; phone (02) 805 0699.



FS meter covers satellite & MMDS

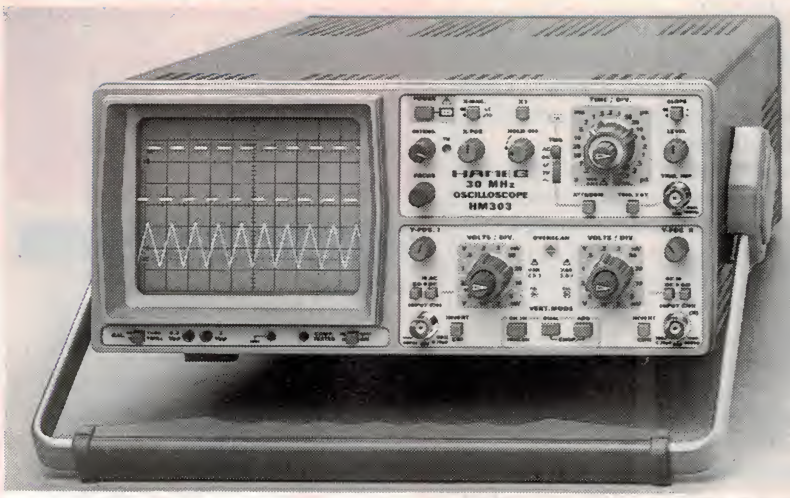
Skandia Electronics has released the Konig APM-380 Field Strength Meter, which is currently being used with great success by installers of Galaxy Pay TV. The APM-380 is capable of measuring signal levels for satellite, terrestrial and MMDS transmission.s

The instrument has been developed to supply the required operating voltage to the MMDS down converter, as well as powering the satellite LNBF. This feature eliminates the need for additional power supplies for the MMDS downconverter, thus allowing easy measurements to be taken direct from the downconverter.

The satellite meter function allows for individual tuning of transponders, while a satellite finder feature faciltates a broad banded sweep of 950 to 2050MHz, which makes satellite location easy. The battery supply allows up to 2.5 hours continual operation of the downconverter. Rechargeable batteries and battery charger, as well as a protective case are supplied with each unit.

A new feature of this model is autocorrection, which eliminates tedious additional calculations and correction curve drop out.

For further information circle 240 on the reader service coupon or contact Skandia Electronics, 183 Burwood Road, Hawthorn 3122; phone (09) 9819 2466.



Improved Hameg 30MHz oscilloscope

The new Hameg model HM303 oscilloscope supersedes the HM203, of which over 170,000 were sold world wide. The bandwidth has been extended from 20MHz to 30MHz, while the top sweep rate has been increased to 10ns/div. The HM303 is therefore very suitable for waveform display in the DC to 70MHz frequency range.

The HM303 offers a special fast rise time 1kHz/1MHz calibrator, permitting high quality probe compensation across the entire frequency range. An overscan indicator assists in vertical display amplitude and position adjustments.

The instrument is capable of triggering on input waveforms over 100MHz and on signal levels as small as half a division. An active video sync-separator permits detailed examination of complex TV signal inputs. The use of a switching power supply minimises both weight and power consumption, and the CRT is fully mu-metal shielded against outside magnetic fields.

The HM303 is supplied standard with an inbuilt component tester, operator's manual and two probes (1:1/10:1). Optional accessories include a viewing hood and carrying case.

For further information circle 205 on the reader service card or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone toll free (008) 335 245.

ISDN tester

Trend Communications has announced the Aurora Duet, an ISDN basic rate tester. The new unit has a totally new architecture but its features complement those of other units in the Aurora range.

The instrument is a second generation ISDN tester, developed to locate and solve specialist problems related to advanced ISDN networks. Its key features include a built-in monitor and decode facility, a choice of three optional U interfaces (2B1Q, 4B3T and UpO) with the ability for all three to be co-resident. The unit can power a network termination device for the UpO U interface

and the S interface, and has storage for up to eight different protocols. Software upgrades of the instrument can be downloaded directly and new protocols added via the use of flash memory.

The tester's monitor facility enables it to extract information from a PBX/network line and capture it into memory for review at a later stage.

For further information contact Trend Communications, Knaves Beech Estate, Loudwater, High Wycombe, Bucks HP10 P9QX, UK; phone (44 628 524 977).

Instrument for EMC testing

Electromagnetic immunity testing to European standards becomes mandatory in Europe in January 1996, and in many other countries including Australia very soon thereafter. Manufacturers of all electrical and electronic equipment from household goods to laboratory equipment will have to perform fast transient and burst voltage EMC tests.

The NSG 2025 family of fast transient and burst interference generators from Schaffner meet all the requirements of the European norms EN50082-1, -2, international standard IEC 1000-4-4 and US requirements ANSI-IEEE C.62.41. Standard test pulses are pre-programmed, custom pulse generation and test management capabilities for detailed design verification and pre-compliance testing.

The NSG 2025 hardware is based on a configurable, modular 'building block' concept which allows users to select pulse generator, one or three phase coupling network, manual and software control elements and UUT (unit under test) connections, to configure an EMC test station to suit the application. Options include a pulse generator with maximum burst amplitudes of 4.4kV or 8kV and network current of 16A or 30A. A maximum burst frequency of 1MHz in the 4.4kV version facilitates detailed product analysis, and offers a generous margin for future modification of world standards.

Instrument control is via a PC Windows based software package WIN 2025, or from a front panel key-pad and display.

The software control package provides built-in IEC standard tests, real time instrument control for custom test set up and optimisation and a comprehensive range of test sequencing, programming and reporting functtons.

For further information circle 210 on the reader service coupon or contact Westinghouse Industrial Products, 179 - 185 Normanby Road, South Melbourne 3205; phone (03) 676 8888.

Portable infrared thermometer

Weighing only 390 grams, the new M100 series portable IR thermometer from Mikron Instrument can detect temperature abnormalities in machinery and industrial processes without contact. A precise laser aiming beam allows accurate targeting and low fatigue operation. Rechargeable NiCad batteries provide up to 20 hours operation.

Called the Hot Spotter, the instrument measures and records temperatures from -50° to +500°C at distances up to 200cm. All the operator does is aim the laser beam and pull the trigger. According to the manufacturer, the unit is ideal for preventative maintenance and detecting a variety of temperature related faults, before serious damage occurs.

Applications include anticipating bearing failures, electrical power and switching faults, blocked steam traps or deteriorating insulation and temperature fluctuations in moving process materials.

For further information circle 211 on the reader service coupon or contact W&B Instruments, PO Box 189, Carlton South 3053; phone (03) 347 0866. ❖

Silicon Valley NEWSLETTER

Gates & Spielberg in interactive venture

It was only a matter of time before the biggest name in Hollywood would team up with the most powerful figure in the personal computer industry. A week after co-founder Paul Allen invested US$500 million in Steven Spielberg's new DreamWorks studio, Microsoft chief Bill Gates held a joint press conference with Spielberg to announce a joint venture to develop interactive entertainment software.

Microsoft and DreamWorks each will contribute half of the US$30 million start-up funding for the 'DreamWorks Interactive' venture, which will focus initially on producing adventure games and interactive stories. The new company will be based largely in Los Angeles, with a smaller group near Microsoft headquarters in Redmond.

"I'm spoiled," said Spielberg, who wore a black baseball cap with the yellow logo of 'Bob', Microsoft's new graphically oriented software system. "I worked with the best studios and the best actors, and it would be silly to get into the interactive business without Microsoft. They're the best company in the world. It does seem like a marriage that was destined to happen."

Industry analysts applauded the deal, saying it will lend legitimacy to the multimedia industry and will help expand the market for CD-ROMs and other interactive software. "These guys are obviously very talented, and what they're doing can only help this industry", said Tom Kalinske, chief executive of Redwood City-based Sega of America.

The new company is expected to come up with as many as two dozen titles a year, with its first original interactive products available for Christmas 1996 and its first potential projects based on its movies and television shows available the following year. Gates said the company will get immediate help from a group of Microsoft programmers and would have the necessary combination of talents to make interactive technology work.

Micron plans US$1.3B chip factory

In a sign that the boom in semiconductor sales is far from coming to an end, US memory chip maker Micron Technology has announced its most ambitious expansion project yet, saying it has decided to build a US$1.3 billion semiconductor plant in Utah. The facility will employ 3500 people at full capacity.

Construction on the new plant will start this spring. It will be located in Utah County, south of Salt Lake City. The new plant is part of Micron's expansion plan which calls for the doubling of its semiconductor manufacturing capacity during the next four years.

The Utah site was selected over two other finalists: Omaha in Nebraska, and Oklahoma City. Micron Chief Executive Officer Steve Appleton said the company liked Utah County's proximity and tax package.

Utah County offered tax increment financing for the plant and to pay for up to US$25 million in infrastructure improvements such as sewer, power, roads and water. The Utah Legislature also added a sales tax exemption for replacing manufacturing equipment, to one already on the books for purchasing new machinery.

As an added bonus for Micron, the proposed site is a short distance from the renowned Brigham Young University and the University of Utah. Micron had said it wanted to be near a university that could meet its employees' continuing and advanced education needs.

It could only happen at a US computer show! At the latest Comdex, in Las Vegas, one of the stands was offering free samples to anyone prepared to put on these top heavy Sumo wrestling outfits and 'have a go'. They had no shortage of takers.

1" 1.5GB hard drives by 2001

One-inch disk drives storing 1.5 gigabytes of data will be available for use in laptop computers as early at the year 2001, according to a team of researchers from IBM and Carnegie-Mellon University who discussed their views of future data storage technology at a gathering of physicists in San Jose.

The tiny future disks, they said, will be made using such materials as gold, platinum or palladium. A major challenge will be to make the recording heads 'fly' so close to the surface of the disk that a mere fingerprint on the platter

would be a mountain-sized obstacle. The tiny drives will find their way into more than just personal computers, where they could provide the user with a built-in complete reference library. They are also likely to find uses inside telephones, fax machines, and voice mail systems.

"To have these by 2001 is not a stretch of the imagination", said Mark Kryder, a professor at Carnegie-Mellon. "Everybody seems to take it for granted that this is simply a progression of the growth line magnetic storage has been on for the last two or three years."

For much of the past two decades, disk drive storage capacity has increased at the rate of 20% every year. But during the past couple of years, thanks to new recording techniques, that rate of increase has reached about 60%.

To keep up the pace, however, "One has to come up with better materials" for both the magnetic platters and the recording heads, said Dieter Weller, a researcher at IBM's Almaden Research Center in San Jose — which has been responsible for the bulk of IBM data storage innovations. Weller said his lab is experimenting with a coating made of an iron-platinum compound, measuring only about two or three atomic layers in thickness.

Weller said with such a thin coating the recording head would have to hover over the surface of the disk at just eight ten-millionths of an inch, rotating at the speed of about 11,000 revolutions per minute.

Both the IBM and other researchers cautioned that magnetic disk drives eventually would reach physical limitations, because the properties of magnetic fields prohibit storing more than about 100 billion bits per square inch. After that, computers might store data using arrays of miniature electron microscopes to manipulate individual atoms — technology that is at least 10 years away, said Hewlett-Packard researcher Gary Gibson.

3Com in two acquisition moves

Corporate network products maker 3Com has announced it will pay US$240 million in stock to acquire two companies that supply computer networking products.

3Com, based in Santa Clara, will buy Primary Access of San Diego for US$170 million and Sonix Communications in the United Kingdom for US$70 million in stock. Both companies will become wholly owned subsidiaries of 3Com, to be known as 3Com Primary Access and 3Com Sonix respectively.

Primary Access gives 3Com a presence in high speed networks that replace various phone lines, data links and modem lines with a single network.

SILICON VALLEY HIRING 'FRENZY'

First there was Silicon Graphics, announcing plans to hire 3000 new workers in 1995. Then came semiconductor equipment maker Applied Materials, saying it is in the process of adding 2900 new jobs. National Semiconductor weighed in, saying it is hiring 200 new people, and finally Lam Research, another chip equipment producer said its payroll will swell by 1400 this year.

It is a hiring spree, the likes of which has not been seen in Silicon Valley since the mid 1980s at the height of the first personal computer boom market. The question remains how long it can last, and whether there are enough people to fill the vacancies.

Silicon Valley is not the only area to benefit from the three year boom in personal computer, software, communications, and semiconductor sales. About half the new jobs announced by Applied and others will be located outside the Valley. That is particularly true in the area of manufacturing jobs, as most firms have relocated production operation outside of the Valley where the cost of living is too high for low to medium skilled labour.

Intel, for example, is in the process of adding several wafer fabs costing more than US$1 billion each. All but one are to be located outside of the Valley.

CompuServe, for instance, uses Primary Access to help link consumers to its computer network system.

Sonix, meanwhile, provides corporations with hybrid phone lines that can deliver both data and voice simultaneously. In the United Kingdom, Sonix has captured 46% of the ISDN market.

IBM to invest US$600M in chip expansion

In yet another major semiconductor plant expansion, IBM has announced that it will invest over US$600 million to expand its fast growing microelectronics business.

Merchant market sales for IBM Microelectronics products and services have increased significantly in the past two years, driving the need for additional investment. In 1994, IBM's merchant microelectronics revenues were approximately US$1.7 billion, more than double the 1993 sales.

Besides its own IC products, IBM has become a major source for contract manufacturing. Among the most visible deals, the company has become the main manufacturing resource for Cyrix and NexGen, two firms developing clones of the Intel x86 series of microprocessors.

"Our vision is to become a leading supplier of highly competitive semiconductor products in the merchant market, and these investments will move us closer to that goal", said Michael Attardo, general manager, IBM Microelectronics Division.

Attardo said this capital investment will allow IBM to better balance its investments among high potential products, including PowerPC microprocessors and embedded controllers, memory, high performance x86-compatible microprocessors, microwave digital signal processors and other products aimed at computer, consumer and communications segments.

CD-ROM sales soared in 1994

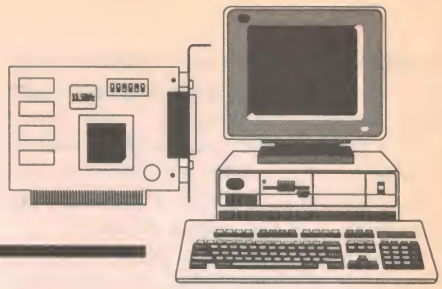
Dataquest has confirmed what was generally known: that CD-ROM sales are soaring in the face of the rapidly growing popularity of multimedia-capable personal computers. Some 53.9 million CD-ROM programs were sold in 1994, Dataquest said, a 227% increase from 16.5 million in 1993.

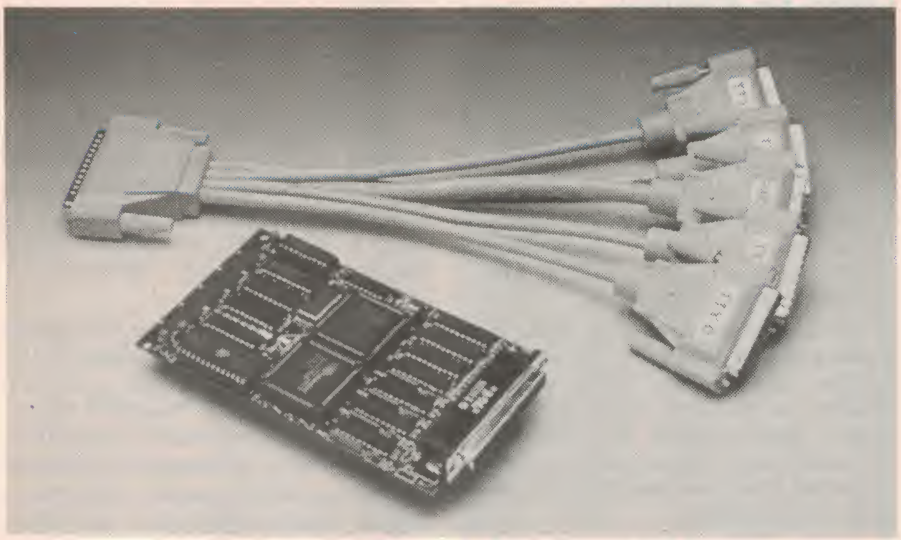
Microsoft shipped the most titles, at 8.3 million units. Trailing Microsoft's 15.4% market share is Mindscape, with 12.4%; Grolier, with 9.4%; Electronic Arts, with 5.5%; and Broderbund Software with 4.7%.

"Games, reference books, and education titles were the big hits of 1994", said Bruce Ryon, director and principal analyst of Dataquest's Multimedia Worldwide program, in a statement. He noted that as developers battle it out for retail shelf space, profit margins on individual CD-ROM titles are being squeezed. The average factory selling price of CD-ROM titles has sunk to a low of US$11 a copy.

CD-ROM titles that come bundled with multimedia computers and kits account for 66% of all CD-ROM title shipments, according to Dataquest's 1994 figures. Some computers come with as many as 50 CD-ROM titles. ❖

Computer News and New Products





4S+P I/O card

The Magma 4+1 Sp is an SBus expansion board that combines four high speed asynchronous serial ports with full modem control and one Centronics parallel port. The board is compatible with Sun Microsystems SPARC computers.

The serial ports operates up to 115.2kb/s and were designed to interface with high speed modems, terminals or any other RS-232 device. The parallel port operates at speeds up to 250,000 char/sec and can be used to connect to high speed printers or plotters. Both serial and parallel ports operate with minimal CPU overhead, achieved by the use of specialised RISC processors with built in buffers. The buffering allows the hardware and software to minimise the number of CPU interrupts.

The supplied device drivers are designed to take advantage of the board's high speed serial and parallel capabilities. The driver is compatible with Solaris 2.x and SunOS 4.1+ and supports all features of both systems. The board is priced at $945.

For further information circle 163 on the reader service coupon or contact Graphics Computer Systems, 22 Harker Street, Burwood 3125; phone (03) 888 8522.

Instrument calibration software

A new version of Fluke Corporation's MET/CAL and MET/TRACK calibration information management software is now available, running under Windows. It provides simplified system configuration, new instrument interfaces and 200 new procedures for a wide range of test instrumentation.

MET/CAL is a PC-based software package that automates the calibration process. It lets users create, edit and document calibration procedures, execute tests under computer control using a wide variety of manual and automated standards, and collect and report test results and issue calibration certificates.

MET/CAL is a measurement oriented asset database that permits users to maintain and report data about the location and application of measurement equipment, calibration history, standards used, traceability to and from national standards, repair history and cost, as well as a host of user defined information. MET/TRACK can be used in a single user application or over a local area network.

Working together, MET/CAL and MET/TRACK satisfy the documentation, reporting and control requirements specified in standards and regulations such as ISO 9000, MIL STD 45662A, FDA GMP, OSHA and others.

For further information circle 161 on the reader service coupon or contact

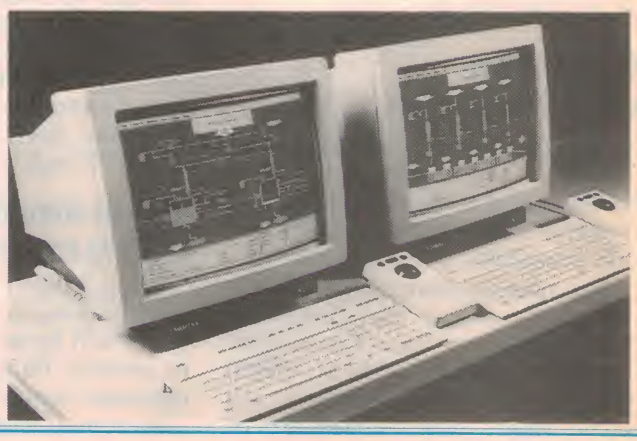
Process Control System

The Simatic PCS is the first process control system from Siemens to combine the power of the distributed control system with the flexibility of the Simatic range of programmable logic controller. Since all the process control functions are configurable, the Simatic PCS offers a high level of system flexibility.

The system has scaleable architecture. Entry level systems can start with a single supervisory workstation and can be expanded to a full blown system with 16 operator workstations. The system can be supplied with an ORACLE interface for seamless integration into management information systems running ORACLE database.

Existing SIMATIC S5 and SIMATIC TI users can upgrade their control system to the SIMATIC PCS and take advantage of the distributed control capabilities.

For further information circle162 on the reader service coupon or contact Siemens, 383 Pacific Highway, Artarmon 2064; phone (02) 436 8624.



I/O card for notebooks

National Instruments has released a low power, low cost parallel digital I/O card for computers with a PCMCIA slot. The DAQCard-DIO-24 is a type II PCMCIA card that can be used for laboratory testing, production testing, and industrial process monitoring and control applications. It includes NI-DAQ and DAQWare software, and is compatible with the company's LabVIEW, LabWindows, and LabWindows/CVI application software products.

The card can connect notebook computers to peripherals with parallel digital I/O, BCD compatible panel meters and test equipment, SSR series solid state relay boards, and so on.

The DAQCard DIO-24 uses a 24-bit PPI, which can be further divided into three 8-bit ports. It features high speed transfer rates up to 250kb/s. With a programmable interval timer, users can generate periodic interrupts for pattern generation. It can operate in either a unidirectional or bi-directional mode, generate interrupt requests, and handshake with peripheral equipment. All functions of the card are software configurable. The PCMCIA bus interface has 16-bit data paths with interrupt-generation circuitry.

For further information circle 164 on the reader coupon or contact National Instruments, PO Box 466, Ringwood 3134; phone (03) 879 9422.

Philips Scientific & Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

'Fastest' docket printer

The Star Micronics SP317 is claimed to be the fastest impact docket printer in the world. Using two nine inch print heads, the SP317 prints bi-directionally at a rate of just under six lines per second.

The printer has been designed for use with electronic devices such as POS units, data storage devices and peripheral equipment used with bank terminals. It allows data to be received while printing is in progress and two external equipment drive circuits enable control of cash drawers and other equipment via a control switch. The standard print colour is violet, however black is optional with the use of a cassette ribbon. Commands for expanded width characters, upside down characters and underlined characters are provided. The printer comes with an RS-

232C serial interface, an optional current loop and RS-422A serial interface. It retails for $980.

For further information circle 172 on the reader service coupon or contact Star Micronics, 107 Asquith Street, Silverwater 2141; phone (03) 748 4300.

Hex speed CD-ROM drive

SCSI Corporation has available what it claims as the world's first six times speed CD-ROM drive. Plextor's 6PleX PX-63 CH is also claimed to offer the fastest throughput and access time available in CD-ROM performance, with 922kB/s data transfer and a 145ms random access. The unit has a 256KB buffer and a 100,000 hour (7% duty) mean time between failures (MTBF) and is backed by a two year parts and labour warranty.

The internal 6PleX PX63CS drive has a list price of $1167 (inc tax), while the external 6PleX PX65CS unit has a list price of $1367 (inc tax).

For further information circle 170 on the reader service coupon or contact SCSI Corporation, 19/9 Hudson Avenue, Castle Hill 2154; phone (02) 894 6033.

Disk drive for audio/video

Micropolis has announced a new generation of AV drives called the AV Gold Javelin series. The new drives feature a minimum sustained transfer rate of 4MB/sec, an improvement in speed of more than 35% over the company's previous disk drive products.

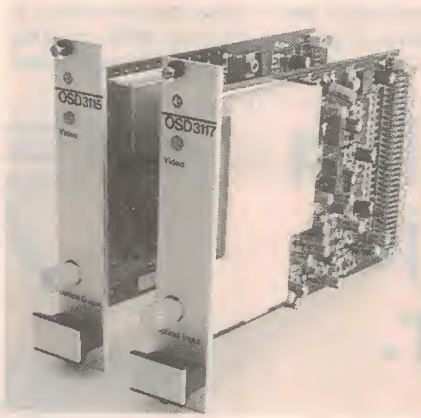
The new drives have been optimised for continuous and sustained delivery of data, eliminating delays in the data stream that cause frame dropouts and jerkiness in digital audio/video playback or recording.

The drives are performance tuned for continuous throughput and maximum bandwidth, offering the high, uninterrupted data rates required for enhanced digital and audio performance in applications such as multimedia, digital video editing and video servers. The series features a 650,000 hour mean time between failure and have a five year warranty when purchased through an authorised Micropolis distributor or reseller.

For further information circle 171 on the reader service coupon or contact Micropolis, 201 Miller Street, North Sydney 2060; phone (02) 959 2298.

Fibre optic modem pair

The OSD3115/OSD3117 is a fibre optic modem pair for the transmission of high quality video and stereo audio. The OSD3115 transmitter accepts balanced or unbalanced video and audio. Termination resistors (75 ohms video, 600 ohms audio) are installed on the board and can be linked by the user if required. When unterminated, the video input impedance is greater than 10k ohms and the audio input impedance is greater than 20k ohms.



The complete system offers greater than 6MHz bandwidth on the video and 15kHz for the audio channels. It will operate over at least 4km of standard multimode fibre while maintaining signal to noise ratios exceeding 50dB for the video and 55dB for the audio.

Units are available either as Eurocard size cards or in standalone 240V AC powered enclosures.

For further information circle 165 on the reader coupon or contact Optical Systems Design, PO Box 891, Mona Vale 2103; phone (02) 913 854

Recycled floppy disks

The GreenDisk is a recycled floppy disk that is claimed to cost less and to perform better than many new disks.

GreenDisks start life as premium quality disk, used by software publishers such as Microsoft. Constant upgrading of software means that many disks are not sold, before becoming superseded.

Software companies were dumping thousands of these 'once used' disks, creating a threat to the environment, as disks take up to 450 years to break down, if dumped as landfill. The disks are collected, wiped clean, formatted and relabelled as premium quality GreenDisks. The disks are available from Greenworld Office Products.

For further information circle 169 on the reader service coupon or contact Greenworld Office Products, PO Box 50, Berwick 3806; phone (03) 796 2413. ❖

Last At These Prices!

Hakko 926 Soldering Station

As we were preparing this advert, exchange rate rises were announced. Current stock ONLY at these prices. DON'T COMPLAIN IN A MONTH'S TIME THAT YOU'VE MISSED THESE LOW PRICES!

The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.

Some people are asking $250!

Our's are still only **$199.95**

We keep 18 Hakko Tips for the 926 in stock plus spare parts, solder etc and other Irons in the Hakko range

DIC SC-7000 DeSoldering Tool ESD* Protected

- Now with 100W ceramic heater
- Sensor feedback digital temperature control
- * Special antistatic housing and zero crossover switching to protect sensitive components
- Suction/Hot air blow switch – suck for desoldering, blow for SMD removal
- Work on up to 12 layer boards

$630 inc tax

Call for tax-free pricing

Includes FREE SMD Plunger for use with optional heads

Special Function ICs

14411	Bit Rate Fqcy Gnrtr	$28.70
14490P	Hex Switch Debounce	$5.15
145026P	Remote Control Encdr	$2.55
145027P	9 Bit Trinary Dcdr	$3.70
145028P	Remote Control Dcdr	$4.80
ICL8038CCJD	Function Generator	$12.35
ICM7209IPA	10MHz Clock Gen.	$12.75
ICM7213IPD	Precision Clock	$17.70
ICM7240IJE	CMOS Timer	$5.75
ICM7555CN	See LMC555CN	
ICM7555IPA	See LMC555CN	
ICM7556IPD	Dual CMOS Timer	$3.55
LM322N	Precision Timer	$1.75
LM331N	Volt/Freq. Comp	$12.20
LM555CN	Timer	$0.80
LM556CN	Dual Timer	$2.80
LM1812N	Ultrasonic Detector	$14.20
LM2907N	Freq./Voltage Comp	$2.60
LM2907N-8	Frequency/Voltage Co	$4.75
LM2917N	Frequency/Voltage Co	$2.55
LM2917N-8	Frequency/Voltage Co	$3.15
LM3905N	Precision Timer	$1.40
LM3909N	LED Flasher/Oscil	$2.85
LM7555CN	See LMC555CN	
LMC555CN	CMOS Timer	$1.15
LMC556CN	Dual CMOS Timer	$3.00
MC33030P	Stepper Driver	$11.75
MM5369AA/N	3.58MHz/60Hz Divider	$3.90
NE558N	Quad Timer	$2.40
SAB6456A	1GHz Swtchbl Presclr	$4.00
TDA1024	Zero X Triac Trigger	$6.00
TEA1100	Fast Battery Charger	$14.25
TEA5501	Encoder/Decoder	$7.60
UC3906N	Lead Acid Charger	$14.85
VRSTR-130V-7MM	130V 7mm Varistor	$1.40
VRSTR-275V-12MM	275V 12mm Varistor	$1.40
XR-2206CP	Function Generator	$10.00
XR-2209CP	Precision Oscillator	$6.35
XR-2240CP	CMOS Timer	$3.00
14409	Binary/Phone Pulse	$11.55
AM7910PC	Until Sold	$28.00
LM565CN	Phase Locked Loop	$4.60
LM566CN	Voltage Cont Oscltr	$1.50
LM567CN	Tone Decoder	$1.05
LMC567CN	CMOS Tone Decoder	$2.40
MC14LC5436P	DTMF Decoder	$5.75
MF4CN-50	4th Order CMOS Filter	$4.45
MF10CCN	Dual Active Filter	$5.20
NE564N	Dgtl Phase Lock Loop	$3.90
NE570N	Compander	$5.70
NE571N	Compander	$4.05
NE572N	Compander	$6.00
TP5088N	DTMF Tone Dialler	$3.60
TP5089N	DTMF Dialler	$2.40
TP5395N	Until Sold	$10.90

Audio Leads

AL-100	5 Pin DIN,Plg to Plg	$7.15
AL-102	5 Pin DIN/4xRCA Plgs	$8.15
AL-103	4 x RCA/4 x RCA Plgs	$8.15
AL-105	8M 6.35mm Stero P to S	$9.95
AL-107	RCA Plug to 2 RCA Skts	$5.05
AL-108	1.2M 3.5mm Plg to Skt	$3.95
AL-116	RCA Plug/Plg	$4.05
AL-116L	3.0M RCA Plg to RCA Plg	$4.95
AL-130	1.2M 5 Pin DIN to 2xRCA	$4.95
AL-142	2 RCA to 2 RCA Plgs	$5.05
AL-142L	2 RCA Plgs to 3.5mm Plg	$4.95
GL-8	Guitar Lead	$14.30

Fly Leads

FL-1	1.8M 75 Ohm Plug/Plg	$5.05
FL-2	1.8M 75 Ohm Plug/Skt	$5.05
FL-4	4.5M 75 Ohm Plug/Plg	$5.95
FL-5	10M 75 Ohm Plug/Plg	$9.95
FL-6	4.5M 75 Ohm Plug/Skt	$5.95
FL-7	10M 75ohm Plg to Skt	$3.45
FL-8	1.8M 75ohm to F Skt	$6.15
FL-21	1.5M Plug to Plg	$6.75
FL-22	3.75M Plg to Skt	$8.75
FL-23	5M 75ohm Plg to Skt	$10.95

Power Leads

IEC-CORD	Computer Cord	$7.95
PL-1	Power Lead,Fig-8 2.0m	$8.15
PL-2	Power Lead,Grooved Rect	$8.15
PL-7	Power Lead Oval Socket	$15.95
PL-8	IEC Extension Cord	$16.95

TV Accessories

AT-6	TV Attenuator	$5.00
DDF772	Splitter/Coupler Coax	$5.95
DDF774	75 Ohm TV & FM Splitter	$7.95
MHB-2	Msthd Baluns 300/75 Ohm	$5.10
MHB-4	Msthd Baluns 300/75 Ohm	$5.70
SUV-7	75 ohm Splitter	$3.90
TV-1	Balun 300/75 Ohm	$2.55
TV-2	Balun 75/300 Ohm	$2.55
TV-3	Coax Entry Box	$3.05
TV-3A	Coax Entry Box	$3.95
TV-4	Splitter Entry Box	$5.05
TV-5	Coax Entry Plate	$7.15
TV-6	Mini Wall Plate	$2.00
TV-7	Standard Plate,One Hole	$4.00
TV-9	75 Ohm Insert	$3.00
TV-10	300 Ohm Insert	$2.00
TV-10A	300 Ohm Insert	$2.00
TV-16	UHF/VHF Band Separator	$9.05
TVS-2	TV Game/Computer Switch	$7.05
VDK-2	Video Dubbing Kit	$25.95

Your Complete Guide To The Huge Range of CONNECTORS from Geoff Wood (Part 2))

Following the popularity of our Semiconductor Listing we're listing all our connectors – *just to show you how comprehensive our range is.* We suggest you photocopy or save this page for future reference!

MACHINE SOCKETS

IC-MACH-06	6 Pin Machine Skt	$0.35
IC-MACH-08	8 Pin Machine Skt	$0.45
IC-MACH-14	14 Pin Machine Skt	$0.75
IC-MACH-16	16 Pin Machine Skt	$0.90
IC-MACH-18	18 Pin Machine Skt	$0.95
IC-MACH-20	20 Pin Machine Skt	$1.15
IC-MACH-22	22 Pin Machine Skt	$1.15
IC-MACH-24	24 Pin Machine Skt	$1.30
IC-MACH-24/SKINN	24 Pin Skinny DIP	$1.40
IC-MACH-28	28 Pin Machine Skt	$1.60
IC-MACH-32	32 Pin Machine Skt	$2.75
IC-MACH-40	40 Pin Machine Skt	$2.30
IC-MACH-64	64 Pin Machine Skt	$3.30

PLCC

IC-PLCC-28	28 Pin Ldless Carrier	$3.15
IC-PLCC-32	32 Pin Ldless Carrier	$2.95
IC-PLCC-44	44 Pin Ldless Carrier	$3.50
IC-PLCC-52	52 Pin Ldless Carrier	$3.75
IC-PLCC-52-SMD	SMD PLCC Socket	$3.75
IC-PLCC-68	68 Pin Ldless Carrier	$2.55
IC-PLCC-84	84 Pin Ldless Carrier	$5.05
IC-SIMM-30	30 Way SIMM Socket	$8.05

SOLDER

IC-TIN-06	6 Pin Solder Skt	$0.20
IC-TIN-08	8 Pin Solder Skt	$0.10
IC-TIN-14	14 Pin Solder Skt	$0.15
IC-TIN-16	16 Pin Solder Skt	$0.15
IC-TIN-18	18 Pin Solder Skt	$0.15
IC-TIN-20	20 Pin Solder Skt	$0.20
IC-TIN-22	22 Pin Solder Skt	$0.25
IC-TIN-24	24 Pin Solder Skt	$0.40
IC-TIN-24-SKINNY	24 Pin Skinny DIP	$0.40
IC-TIN-28	28 Pin Solder Skt	$0.25
IC-TIN-40	40 Pin Solder Skt	$0.35

TRANSITION SOCKETS

IDC-TRANS-10-P	10 Way Plg	$4.60
IDC-TRANS-10-PCB	PCB Prllel Pins	$1.55
IDC-TRANS-10-S	10 Way Skt	$0.60
IDC-TRANS-14-P	14 Way Plg	$1.55
IDC-TRANS-14-S	14 Way Skt	$1.35
IDC-TRANS-16-P	16 Way Plg	$1.60
IDC-TRANS-16-S	16 Way Skt	$0.85
IDC-TRANS-20-P	20 Way Plg	$7.35
IDC-TRANS-20-S	20 Way Skt	$0.80
IDC-TRANS-26-P	26 Way Plg	$1.95
IDC-TRANS-26-S	26 Way Skt	$0.85
IDC-TRANS-34-P	34 Way Plg	$11.05
IDC-TRANS-34-S	34 Way Skt	$0.90
IDC-TRANS-40-S	40 Way Skt	$1.30
IDC-TRANS-50-S	50 Way Skt	$1.90
IDC-TRANS-60-S	60 Way Skt	$3.15

HEADERS

BOX RIGHT ANGLE

IDC-HDR-BX-RA-10	10 Way Boxed	$1.45
IDC-HDR-BX-RA-14	14 Way Boxed	$2.10
IDC-HDR-BX-RA-16	16 Way Boxed	$1.05
IDC-HDR-BX-RA-20	20 Way Boxed	$2.80
IDC-HDR-BX-RA-26	26 Way Boxed	$3.35
IDC-HDR-BX-RA-34	34 Way Boxed	$3.85
IDC-HDR-BX-RA-40	40 Way Boxed	$5.70
IDC-HDR-BX-RA-50	50 Way Boxed	$6.40
IDC-HDR-BX-RA-60	60 Way Boxed	$7.80

BOX STRAIGHT

IDC-HDR-BX-ST-10	10 Way Boxed	$0.50
IDC-HDR-BX-ST-14	14 Way Boxed	$1.75
IDC-HDR-BX-ST-16	16 Way Boxed	$0.85
IDC-HDR-BX-ST-20	20 Way Boxed	$1.30
IDC-HDR-BX-ST-26	26 Way Boxed	$1.70
IDC-HDR-BX-ST-34	34 Way Boxed	$4.05
IDC-HDR-BX-ST-40	40 Way Boxed	$4.35
IDC-HDR-BX-ST-50	50 Way Boxed	$5.95
IDC-HDR-BX-ST-60	60 Way Boxed	$6.80

RIGHT ANGLE WITH LATCHES

IDC-HDR-RA-10	10 Way	$1.65
IDC-HDR-RA-14	14 Way	$2.35
IDC-HDR-RA-16	16 Way	$2.55
IDC-HDR-RA-20	20 Way	$3.20
IDC-HDR-RA-26	26 Way	$4.10
IDC-HDR-RA-34	34 Way	$5.35
IDC-HDR-RA-40	40 Way	$5.75
IDC-HDR-RA-50	50 Way	$7.90
IDC-HDR-RA-60	60 Way	$8.60
IDC-HDR-RA-64	64 Way	$10.05

STRAIGHT WITH LATCHES

IDC-HDR-STR-10	10 Way	$1.05
IDC-HDR-STR-14	14 Way	$1.95
IDC-HDR-STR-16	16 Way	$1.90
IDC-HDR-STR-20	20 Way	$2.35
IDC-HDR-STR-26	26 Way	$3.40
IDC-HDR-STR-34	34 Way	$4.40
IDC-HDR-STR-40	40 Way	$4.90
IDC-HDR-STR-50	50 Way	$6.50

PIN HEADERS

PIN-HDR-LNG-1X36	Straight 1x36	$4.10
PIN-HDR-RA-1X40	R/A 1x40 Pins	$1.30
PIN-HDR-RA-2X40	R/A 2x40 Pins	$1.95
PIN-HDR-STR-1X40	Straight 1x40	$0.65
PIN-HDR-STR-2X40	Straight 2x40	$1.15

SHUNTS

SHUNT-BLK/10	0.1 Blk Per 10	$0.65
SHUNT-BLK/100	0.1 Blk Per 100	$6.05
SHUNT-BLK/500	0.1 Blk Per 500	$30.30

SQUARE POST HEADER SOCKETS

SQP-DIL-MACH-50	50 Way	$22.00
SQP-SIL-MACH-36	36 Way	$8.00

Video Leads

VL-1	1.5m BNC Plug/Plg	$8.75
VL-2	3M 75 Ohm BNC Plug/Plg	$4.00
VL-5	RCA to RCA	$4.40
VL-6	1.5m 75ohm BNC to RCA	$6.70
VL-7	1.5m 75 Ohm RCA/Coax Pl	$5.00
VL-9	20cm 5 Pin DIN to 4xRCA	$6.05
VL-15	1.5m 6 Pin DIN Plg to P	$8.05
VL-21	1.5m SCART TO 6 Pin DIN	$10.00
DEGAUSSING-WAND	240V Degaussing Wand	$99.95

About to buy a Multimeter?

Then check our prices for the best in the business

FLUKE

LM3886 50W Amplifier IC

This is the IC used in Silicon Chip's 50W stereo amplifier project (Feb 95). This monolithic IC delivers slightly more power than the LM3876. Output is 48W into 8Ω or up to 60W into 4Ω with a frequency response from 16Hz to 200kHz ±1dB! Input sensitivity is 870mV and harmonic distortion is typically <0.005%. Signal to noise is 107dB unweighted. Only requires a handful of parts to make a power amp with no complicated fiddling to set up. No quiescent adjustment, better thermal stability and short-circuit proof!

IC is only **$12.75**

LM1875 20Watt Power Audio Amp

Delivers 20W into 4 or 8Ω load using ±25V supply. Can get up to 30W into 8Ω with ±30V. Minimum of external parts. See Silicon Chip Dec 93 **$4.40**

8.30am to 5.00pm Mon to Thurs., 8.30am to 4.30pm Friday.
Mail Orders add $5.00 min to cover postal charges.
Next day delivery in Sydney add $8.00.
All prices include Sales Tax unless stated otherwise.
Tax exemption certificates accepted if the line value exceeds $10.00.
BANKCARD, MASTERCARD, VISA, CHEQUES or CASH cheerfully accepted. READER INFO NO. 11

GEOFF WOOD ELECTRONICS

Geoff Wood Electronics Pty Ltd and Semtech

(inc in N S W)

229 Burns Bay Road, Lane Cove West
N S W 2066 (Corner Beatrice Street)

Telephone : (02) 428 4111 Fax : (02) 428 5198

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	•	•	•	•	•	•	•
Companion Computers	VIC		•					
Dick Smith Electronics	ALL	•	•	•	•	•	•	•
Emona Instruments	NSW						•	
Geoff Wood Electronics	NSW	•	•	•	•	•	•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
Kalex	VIC			•				
Macservice	VIC						•	
RCS Radio	NSW			•				
Rod Irving Electronics	Eastern	•	•	•	•	•	•	•
Scientific Devices	VIC						•	
TECS	VIC	•	•	•	•	•	•	•
Wagner Electronics	NSW		•		•	•	•	

KEY TO CODING:
A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co, PO Box 199, Alexandria 2015; phone (02) 353 9992.
BACK ISSUES: Available only until stocks are exhausted. Price A$7.50 which includes postage within Australia only. **OVERSEAS READERS SHOULD ADD A FURTHER A$2.50 FOR EVERY BACK ISSUE REQUIRED.**
PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.
PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.
PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications.
Members of our technical staff are not available to discuss technical problems by telephone.
OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.
PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).
ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.
PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

METHOD OF PAYMENT: (Please circle correct method).

Credit Card: Mastercard
Cheque: American Express
Money Order: Visa
Bankcard

Expiry Date: .....

Name:.....
Address:.....
....Postcode:.....
Back Issues:.....
.....
.....
Photostat Copies:.....
.....
.....

No.of issues required:.....$7.50=.....
No.of copies required:.....$5.00=.....
No.of copies required:...$15.00=.....
Total Payment Enclosed $ =========

Signature:.....
(Unsigned orders cannot be accepted).

ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

COLOUR MONITOR

German made, used but guaranteed 12" mains powered **colour computer** monitors, with bright Toshiba tubes. 9-pin DIN connector for signal inputs, brief information supplied. We will soon have a kit available to make these sets into the ULTIMATE MUSICOLOUR: a new colour display for each beat of music. Ideal for experimenting with **$40**

12V-2.5W SOLAR PANEL SPECIAL

These US made amorphous glass solar panels only need terminating and weather proofing. We provide terminating clips and a sheet of glass. The terminated panel is glued to the backing glass, around the edges only. For improved looks, inexpensive plastic L angle can be glued to the edges. Very easy to make. Dimensions: 305x228mm, Voc: 18-20V, Isc: 250mA. SPECIAL REDUCED PRICE! **$20 ea. or 4 for $60.** Each panel is provided with a sheet of backing glass, terminating clips, isolating diode and instructions. A very efficient switching regulator kit is also available: Suits 12-24V batteries, 0.1-16A panels, **$27.** Also available, a simple and efficient shunt regulator kit, **$5.**

MOTORS

Small powerful **GEARED AC** motor. 1 RPM/60Hz/24V/5W. We supply a circuit diagram that shows how to power this motor from 12V DC: Variable speed/full power (Bridge output). Bargain priced: **$9**

MOTOR SPECIAL: These motors can also double up as generators. Type M9: 12V, I no-load = 0.52A - 15,800 RPM at 12V, 36mm dia, 67mm long, **$5.** Type M14: made for slot cars, 4-8V, I no-load = 0.84A at 6V, at max efficiency I = 5.7A - 7500 RPM, 30mm dia, 57mm long, **$5**

LOW COST IR ILLUMINATOR

Has 42 high-output 880nm IR LEDs (30mW @ 100mA ea), and a 7 transistor adjustable constant current driver circuit Operates from 10-14V DC, current adj range 5-600mA. Compact PCB designed to replace lid on a standard 82 x 53 x 28mm plastic box.s Good for illuminating IR responsive CCD cameras, IR and passive night viewers, medical use. Kit includes box, low price: **$40**

VEHICLE COMPUTER

Originally for bicycles, these suit any moving vehicle with wheels! 9-function computer with speed, average speed, maximum speed, distance, odometer, timer, scan, freeze frame memory, and a clock. Microprocessor circuitry can be adapted to work with almost any wheel diameter. Divide the wheel diameter in millimeters by 6.8232, and program the result into the computer. **$29.90**

IR REMOTE SWITCH

Consists of a PCB and all on-board components for an IR receiver with a toggle output. Includes a new commercial ready-made slimline IR remote control transmitter, designed for a CD player. Press any button on the IR transmitter to toggle the output on the receiver: The system has up to 20m range and also works from most other IR remote controls! Receiver has an IC "front end" and operates from 8-15V DC, and will drive a relay. Transmitter operates from two AAA batteries (Not supplied). Unbelievable pricing: **$18** Suitable 12V 8A relay with 4kV isolation: **$3**, 12V DC plugpack: **$10**

LOW COST PIR

PIR movement detector, based on a single LSI IC design, features simple construction, even the lens assembly snaps onto the PCB. Has every possible feature: negligible power consumption, adjustable daylight disable with supplied LDR, 10m range, variable alarm time, disable input, 10A MOSFET output, 10-20V DC operation. Fits into the smallest zippy box! Complete kit (PCB & all on-board components) for only **$18**

COMPONENTS

SUPERCAPS 0.047F 5.5V **5 for $2**

CASED TRANSFORMER 230: 1.7V 300mA AC - in small plastic case with 2m long input and output leads: **$6**

PCB WITH AD7581LN IC: PCB with many components with a MAXIM AD758ILN IC, 8-bit, 8-channel memory buffered data acquisition system designed to interface with microprocessors, **$29.**

POWER SUPPLY

Used, clean non-standard computer power supplies, in perforated metal casing for air circulation, built-in fan, IEC input connector and OFF-ON switch, "flying" DC output leads, dimensions: 87 x 130 x 328mm, 110-220V input, +5V @ 8A, +12V @ 3A, and -12V @ 0.25A DC outputs. BARGAIN: **$18 ea. or 4 for $60**

CABLES

IEC EXTENSION LEADS: 2m, with IEC plug and IEC socket **$5.**

MODULAR TELEPHONE CABLES 4 way modular curled cable with plugs each end, also a 4m 8-way modular flat cable with plugs each end, one of each for: **$2**

WELLER SOLDERING IRON TIPS

New soldering iron tips for low voltage Weller soldering stations and mains operated Weller irons. Mixed popular sizes and temperatures. Specify mains or soldering station type: **5 for $10.**

VIDEO TRANSMITTERS

low power PAL standard UHF transmitters. Have audio and video inputs with adjustable levels, a power switch and a power input socket: 10-14V DC/10mA operation. Enclosed in a small metal box with an attached telescopic antenna. Range is up to 10m with the telescopic antenna supplied, but can be increased to approximately 30m by the use of a small directional UHF antenna. INCREDIBLE PRICING: **$25.**

MORE ITEMS & KITS

Poll our **(02) 579 3955 or (02) 579 4985** fax numbers to find out how to get our item and kit lists. MANY MANY MORE ITEMS AND KITS THAN THOSE LISTED HERE! *Ask for these lists to be sent with your next order.*

KITS

NEW! **MODEL TRAIN KIT**

Run two trains on one track without collisions! Kit includes 2 IR LEDS, 2 IR detectors, 2 small PCBs and a controller PCB with on-board components for LED signal lights. Also doubles as a crossing controller with flashing LEDs. INCREDIBLE PRICING: **$20.**

SINGLE CHANNEL UHF REMOTE CONTROL SC Dec. 92, one Tx and Rx: **$45**, extra Tx **$15.**

4-CHANNEL UHF REMOTE CONTROL KIT: Two Tx & 1 Rx **$96**.

LOW COST 1-2 CHANNEL UHF REMOTE CONTROL A single channel 304MHz UHF remote control with over 1/2 million code combinations with provision for a second channel expansion. The low cost design includes a complete compact keyring transmitter kit, which includes a case and battery, and a PCB and components kit for the receiver that has 2A relay contact output!. Tx kit **$10**, Rx kit **$20** additional components to convert the receiver to 2 channel operation (Extra decoder IC and relay) **$6**. INCREDIBLE PRICES: complete 1 channel Tx-Rx KIT: **$30** complete 2 channel Tx-Rx kit: **$36** additional transmitters: **$10**

MASTHEAD AMPLIFIER KIT: Two PCBs plus all on-board components: Low noise (uses MAR-6 IC), covers VHF-UHF, **$18**

LASER BEAM COMMUNICATOR KIT: Tx, Rx, plus IR laser: **$60**

ELECTRIC FENCE KIT: PCB and components, includes prewound transformer: **$40**

FM TRANSMITTER KIT - MK1 This complete transmitter kit (miniature microphone included) is the size of an AA battery, and is powered by a single AA battery. Use a two AA battery holder (provided) as the case, and a battery clip (shorted) for the switch. Battery life is over 500 hours!! **$11**

PLASMA BALL KIT: PCB and components kit, needs any 240V light bulb, **$25.**

BRAKE LIGHT INDICATOR KIT: 60 LEDs, two PCBs and ten resistors, makes a very bright 600mm long, high intensity red display, **$25.**

GARAGE DOOR - GATE REMOTE CONTROL KIT: Tx **$18**, Rx **$79.**

1.5-9V CONVERTER KIT: $6 ea. or 3 for **$15.**

DOT MATRIX LCDs

Brand new Hitachi LM215 400 X 128 dot matrix liquid crystal displays in an attractive housing. These have driver ICs fitted but require an external controller. Effective display size is 65 x 235mm. Priced at less than 10% of their real value: **$25 ea. or 3 for $60**

$215 CCD VIDEO SECURITY SYSTEM

Mono CCD camera on a small PCB. Includes auto iris lens. Works with illumination to 0.1 lux and is IR responsive. This new camera is nearly 1/2 the size of the unit previously supplied, almost match box size! Can be used in total darkness with IR illumination: **NEW LOW PRICE $180.**

We can also supply with each camera a used, guaranteed 12V DC green computer monitor and a simple kit to convert it to work with the CCD camera. Monitor **$25**, kit **$10.**

A COMPLETE 12V CCD VIDEO SECURITY SYSTEM FOR $215!!

LASERS

MAINS LASER SPECIAL Includes a compact potted US made power supply which can be powered from 110/220-240V AC, a 2-3mW He-Ne tube, a ballast resistor and instructions. The power supply requires 4-6V @ 2mA DC. Brand new components. Giveaway price: **$65**

ARGON LASER Large water cooled ARGON laser that outputs 7W of blue - green, or 1W of red via an inbuilt Dye laser. Originally for medical use, has only had 200 hours of use! **$12000**

AIR-COOLED ARGONS Used argon-ion heads with 30-100mW output in the blue/green spectrum. Includes circuit details of power supply and other information: head only: **$300**

VISIBLE LASER DIODE MODULES Industrial quality 5mW/670nm laser diode modules. Overall dimensions: 11mm dia x 40mm long. Have APC driver built in and need about 50mA from a 3-6V supply: **$60**

IMAGE INTENSIFIER TUBES

Used but in excellent condition, second generation image intensifier tubes. Can be used to make small and very sensitive scope that can produce high resolution pictures in very low illumination. US made tubes that produce superior results! **$350 to $650**

BLEMISHED 3-STAGE TUBES We have a good number of 40mm three stage fibre optically coupled 3-stage image intensifiers that have minor blemishes: Similar to above but three tubes are supplied already bonded together: Extremely high gain!! Each of these tubes will be supplied with the power supply components only. See SC Sept. 94. **$200** (Back copy SC Sept 94: **$5**)

OATLEY ELECTRONICS

PO Box 89, Oatley NSW 2223

Phone (02) 579 4985 Fax (02) 570 7910 or 579 3955

major cards accepted with phone and fax orders

P&P for most mixed orders Aust $6.

READER INFO NO. 37

ICOM

Count on us!

INTRODUCING THE FIRST HANDHELD CB WITH BUILT-IN SELCALL

Innovation keeps ICOM ahead.

At Icom our leadership in CB is built on innovation. And once again, ICOM is first with the latest, the new IC-40GX. The smallest handheld UHF CB and the first with built-in SELCALL. Now when you want one-to-one, uninterrupted communication, there's no need to go to the extra expense of retrofitting. The IC-40GX allows you to send or receive calls from a specific individual or group. Each unit is factory-programmed with its own unique code and can monitor continuously, in quiet mode, until a selective call signal is received. You receive the calls that are specifically for you with no disturbing outside chatter. It makes UHF CB simple and as convenient to use as a handphone.

Feature after feature, ICOM puts you first.

You can program your ten most frequently-called numbers for single button speed calling. You also get call-back acknowledgement and Group Call to as many as 100 stations.

There's up to a full 5W of output power with a Hi/Lo transmission switch to conserve power and a power save mode on receive. Plus a one touch Channel 5 emergency channel, and much more.

Discover the innovative features, the clarity and performance of the new IC-40GX for yourself at your nearest Icom dealer soon.

Icom Australia 7 Duke St Windsor Victoria 3181 A.C.N. 006 092 575
Free Call: (008) 338 915 Ph: (03) 529 7582 Fax: (03) 529 8485

READER INFO NO. 38

L.L. BROWN ADVERTISING 4803